US005790652A

United States Patent [19]

Gulley et al.

[11] Patent Number: 5,790,652

[45] Date of Patent: Aug. 4, 1998

[54] **TELEPHONE STATION EQUIPMENT EMPLOYING REWRITEABLE DISPLAY KEYS**

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[73] Assignee: **Intergrated Systems, Inc.**, Nashua, N.H.

[21] Appl. No.: **615,591**

[22] Filed: **Mar. 12, 1996**

[51] **Int. Cl.**[6] **H04M 1/00**

[52] **U.S. Cl.** **379/368**; 379/433; 379/356

[58] **Field of Search** 379/355, 354, 379/216, 368, 93.17, 93.18, 93.19, 93.23, 433, 434

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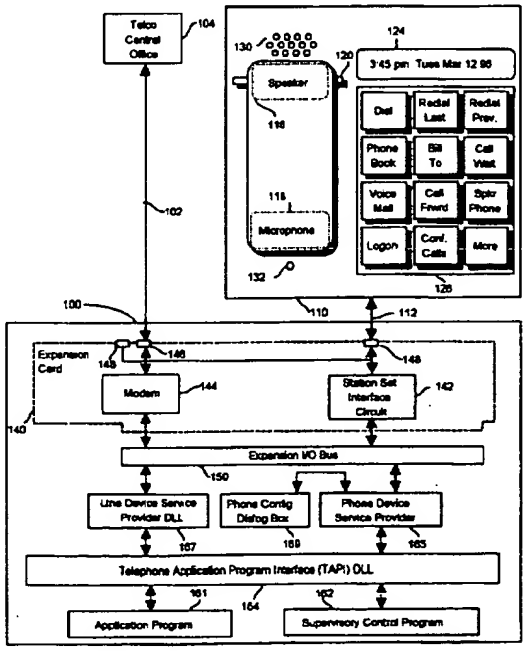
Primary Examiner—Jack Chiang

Attorney, Agent, or Firm—Banner & Witcoff Ltd.

[57] **ABSTRACT**

Telephone station equipment consisting of a phone device interconnected with a personal computer. The phone device includes a conventional telephone handset and a keypad employing pushbutton display keys each of which has a writable keyface display for visually indicating the function of the key or other information to the user. The personal computer is connected to both the phone device and to one or more telephone communications channels and is programmed to display prompting information on the key displays and respond to keypress events to perform the functions indicated. The user can perform a variety of telephone system management tasks solely by viewing and manipulating the phone device keypad, including manual dialing, redialing, speed-dialing from a directory of commonly called numbers, making flash disconnections, forwarding calls, controlling call waiting and caller LD. functions, adjusting speakerphone volume and microphone gain, handling conference calls, automatically logging into remote databases, recording the time and nature of each call in an accounting file, performing unattended call answering and voice mail functions, utilizing voice responsive and automated voice output systems, and other telephone management functions.

27 Claims, 8 Drawing Sheets



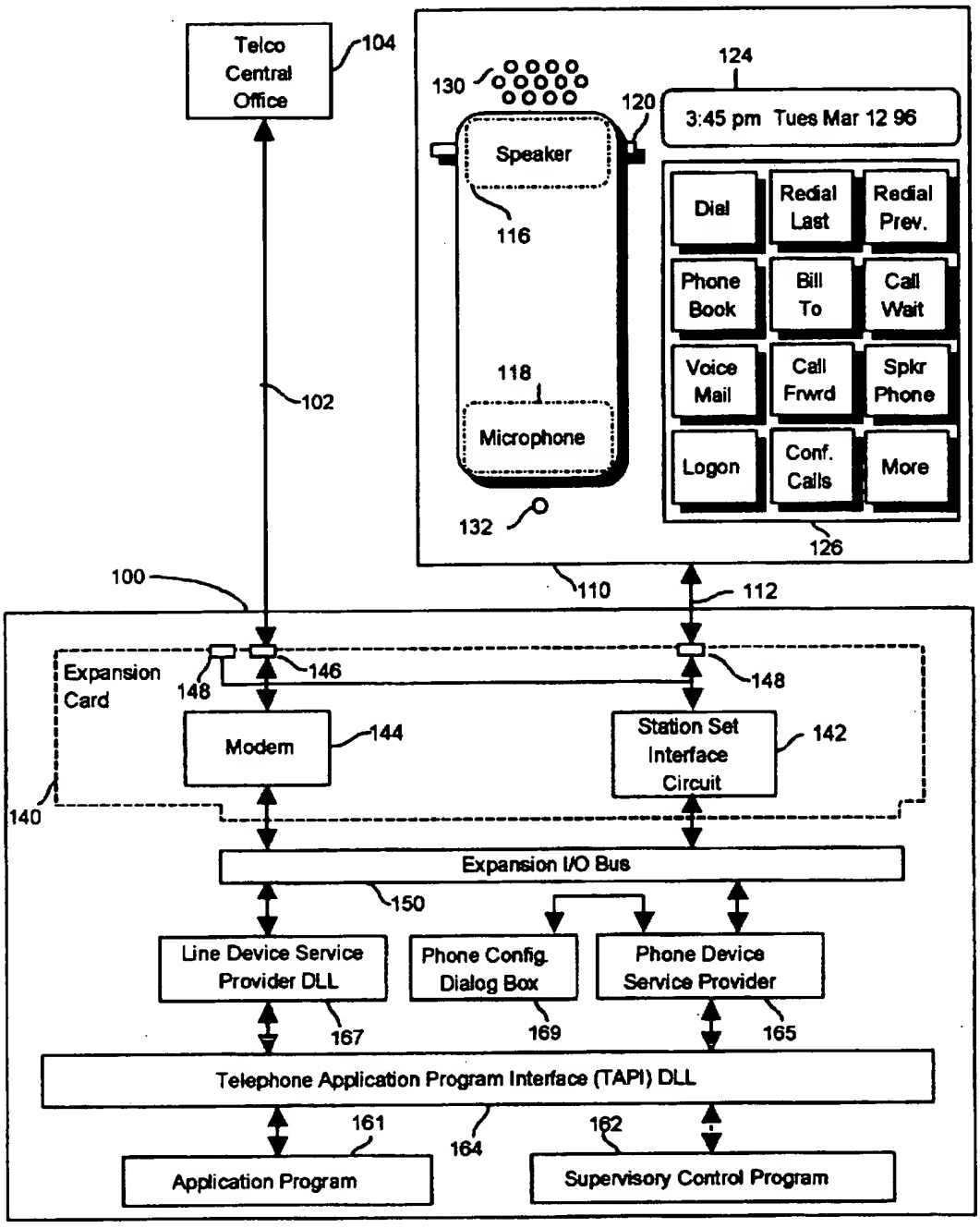

Telco Central Office
104
130
124
120
3:45 pm Tues Mar 12 96
Speaker
116
Dial
Redial Last
Redial Prev.
Phone Book
Bill To
Call Wait
Voice Mail
Call Frwrd
Spkr Phone
Logon
Conf. Calls
More
118
Microphone
132
126
102
100
110
112
Expansion Card
148
146
148
Modem
144
Station Set Interface Circuit
142
140
Expansion I/O Bus
150
Line Device Service Provider DLL
Phone Config. Dialog Box
Phone Device Service Provider
167
169
165
Telephone Application Program Interface (TAPI) DLL
161
164
162
Application Program
Supervisory Control Program

Fig. 1

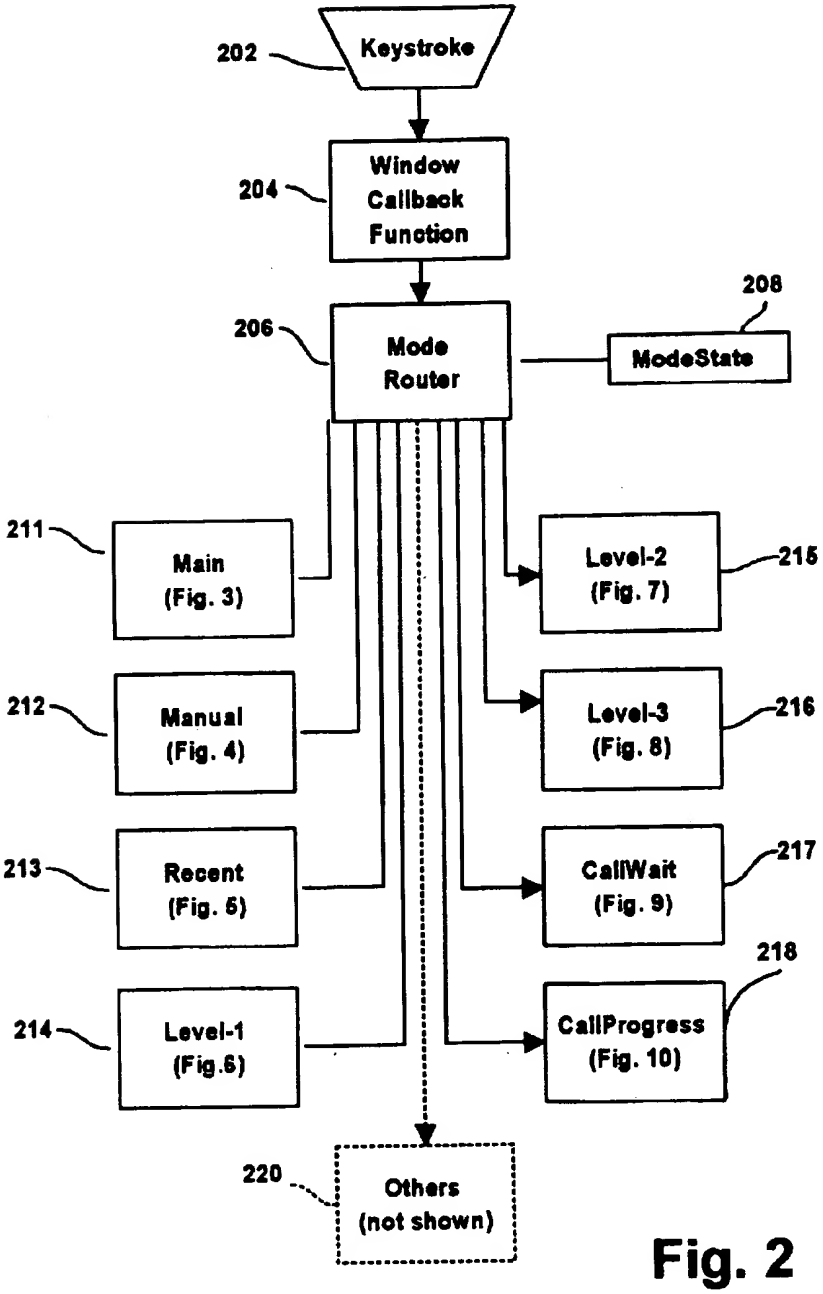

202
Keystroke
204
Window Callback Function
206
Mode Router
208
ModeState
211
Main (Fig. 3)
212
Manual (Fig. 4)
213
Recent (Fig. 5)
214
Level-1 (Fig.6)
215
Level-2 (Fig. 7)
216
Level-3 (Fig. 8)
217
CallWait (Fig. 9)
218
CallProgress (Fig. 10)
220
Others (not shown)

Fig. 2

Fig. 3

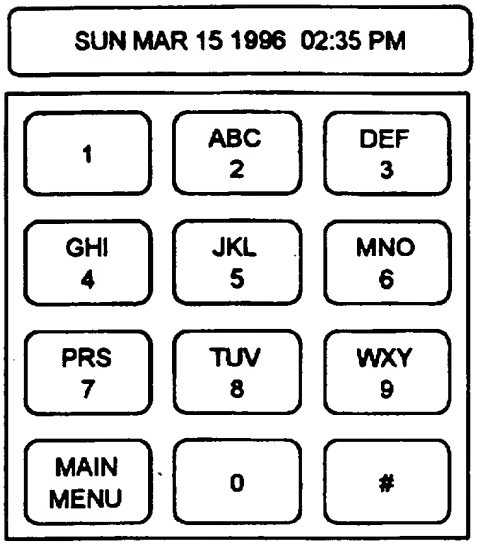


Fig. 4

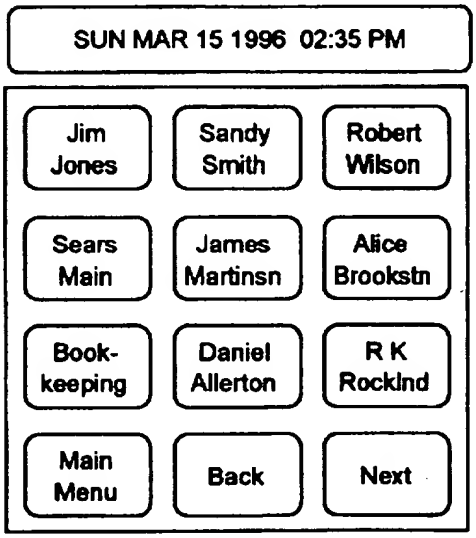


Fig. 5

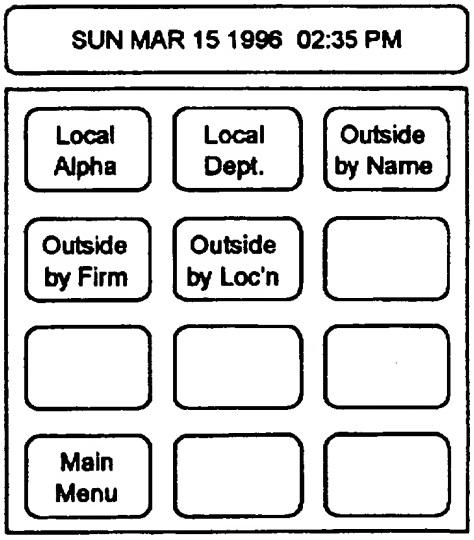


Fig. 6

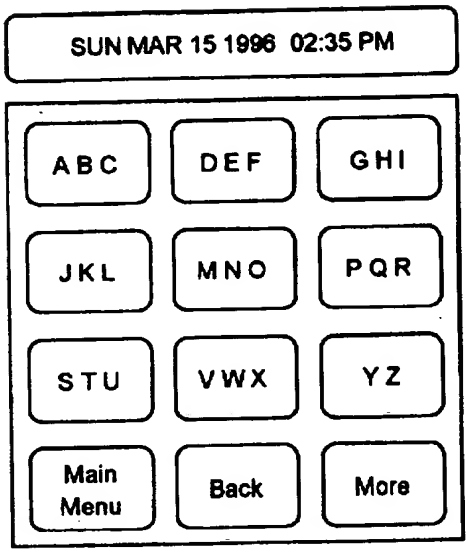


Fig. 7

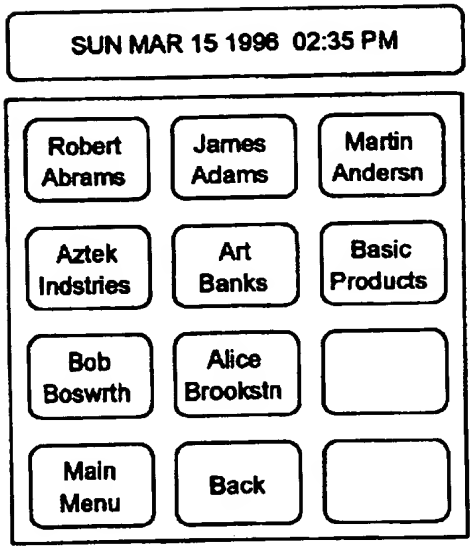


Fig. 8

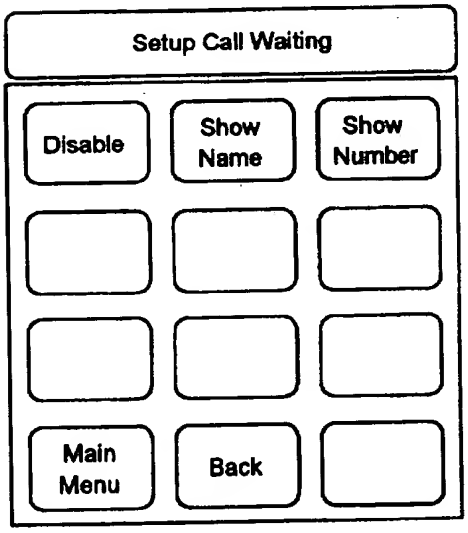


Fig. 9

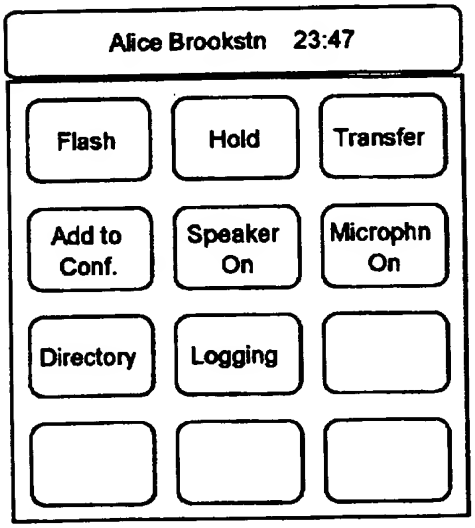


Fig. 10

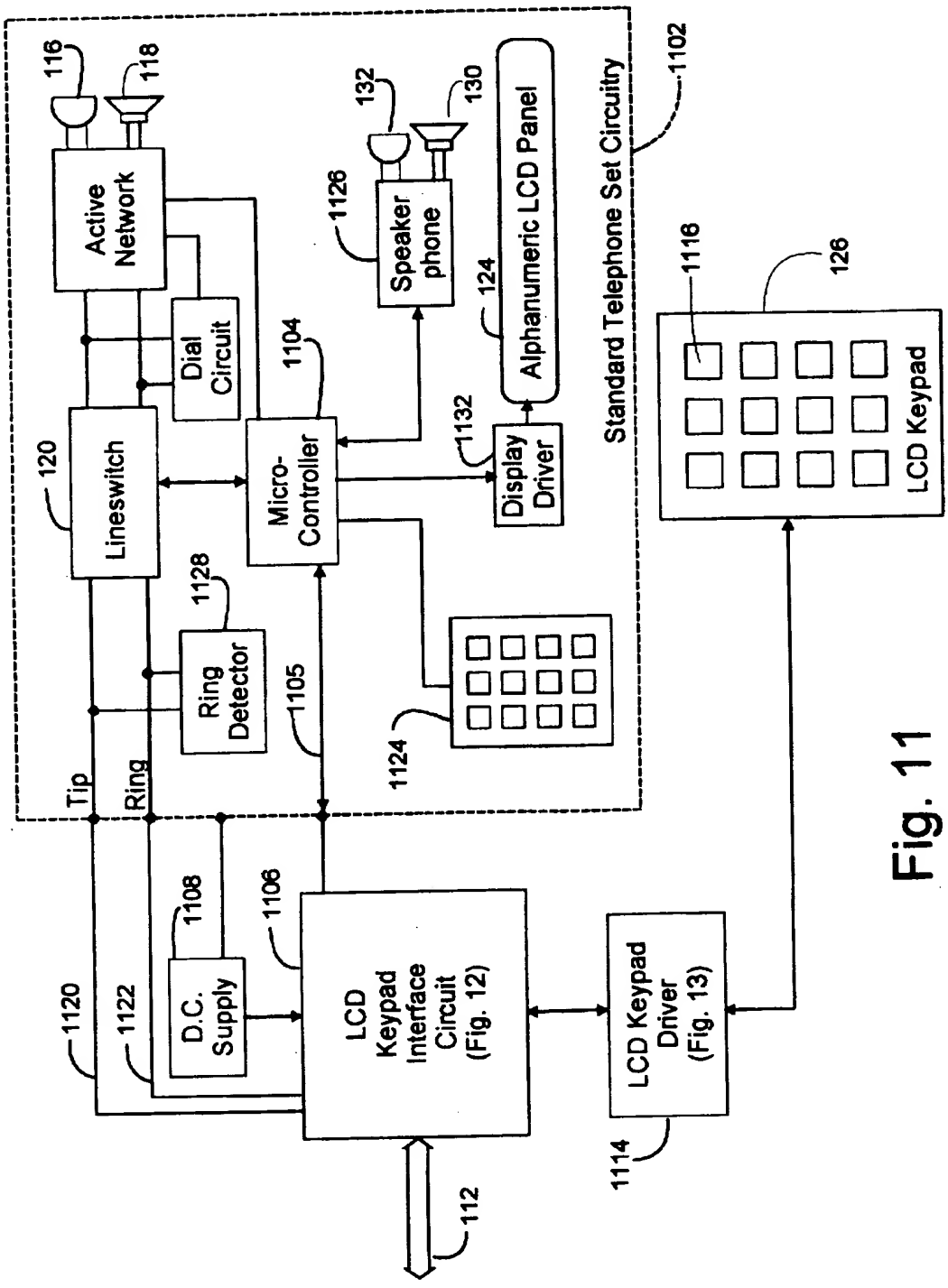

Standard Telephone Set Circuitry
1102
116
118
Active Network
120
Lineswitch
Dial Circuit
1104
Micro-Controller
132
130
Speaker phone
1126
124
Alphanumeric LCD Panel
Display Driver
1132
1128
Ring Detector
1105
1124
Tip
Ring
1108
1106
1120
1122
D.C. Supply
LCD Keypad Interface Circuit (Fig. 12)
112
LCD Keypad Driver (Fig. 13)
1114
1118
126
LCD Keypad

Fig. 11

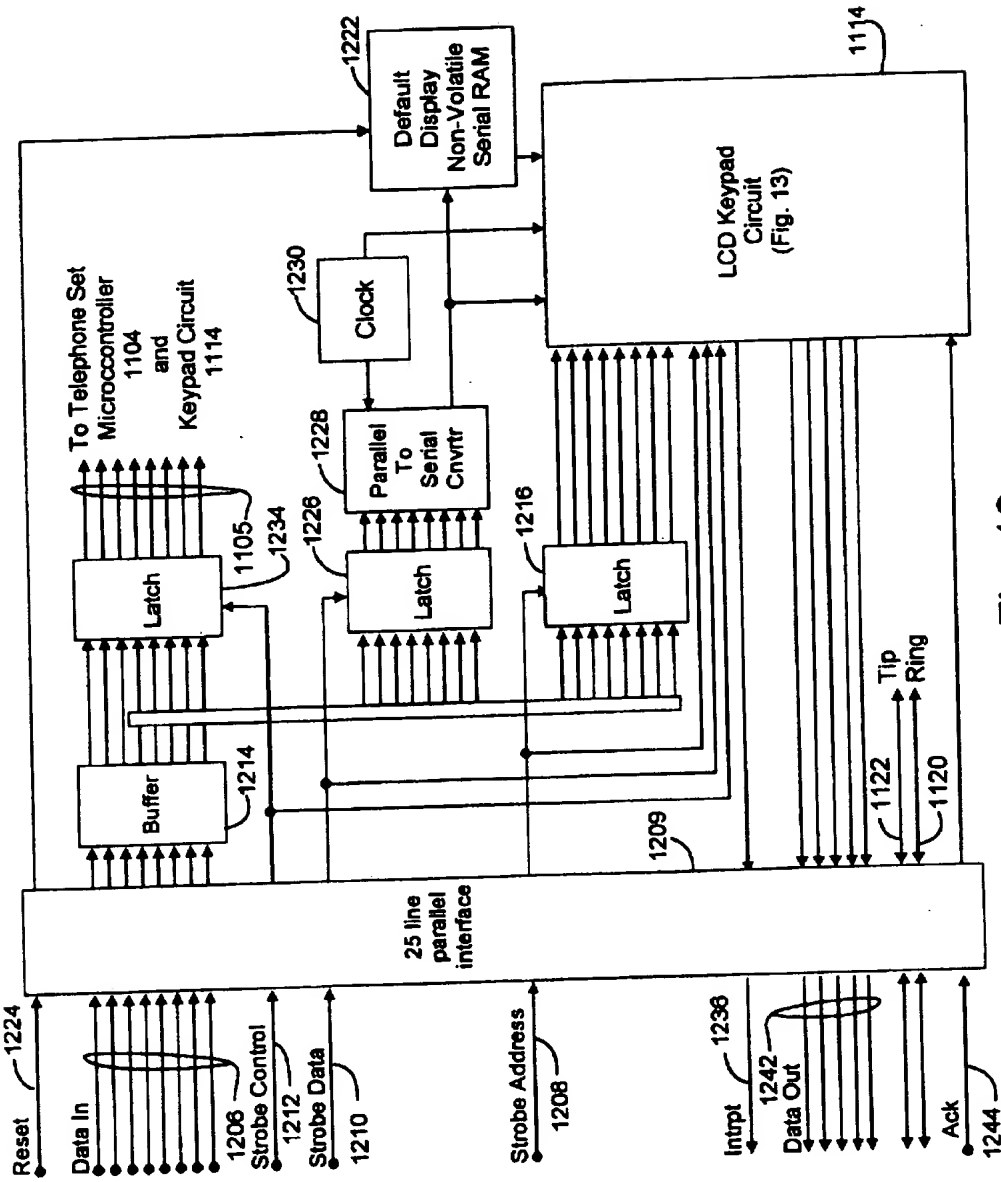

1222
Default Display Non-Volatile Serial RAM
1114
LCD Keypad Circuit (Fig. 13)
1230
Clock
To Telephone Set Microcontroller 1104 and Keypad Circuit 1114
1228
Parallel To Serial Cnvrtr
1226
1234
1105
1216
Latch
Latch
Latch
Buffer
1214
Tip
Ring
1122
1120
1209
25 line parallel interface
1224
Reset
Data In
1206
Strobe Control
1212
Strobe Data
1210
Strobe Address
1208
1236
Intrpt
1242
Data Out
Ack
1244

Fig. 12

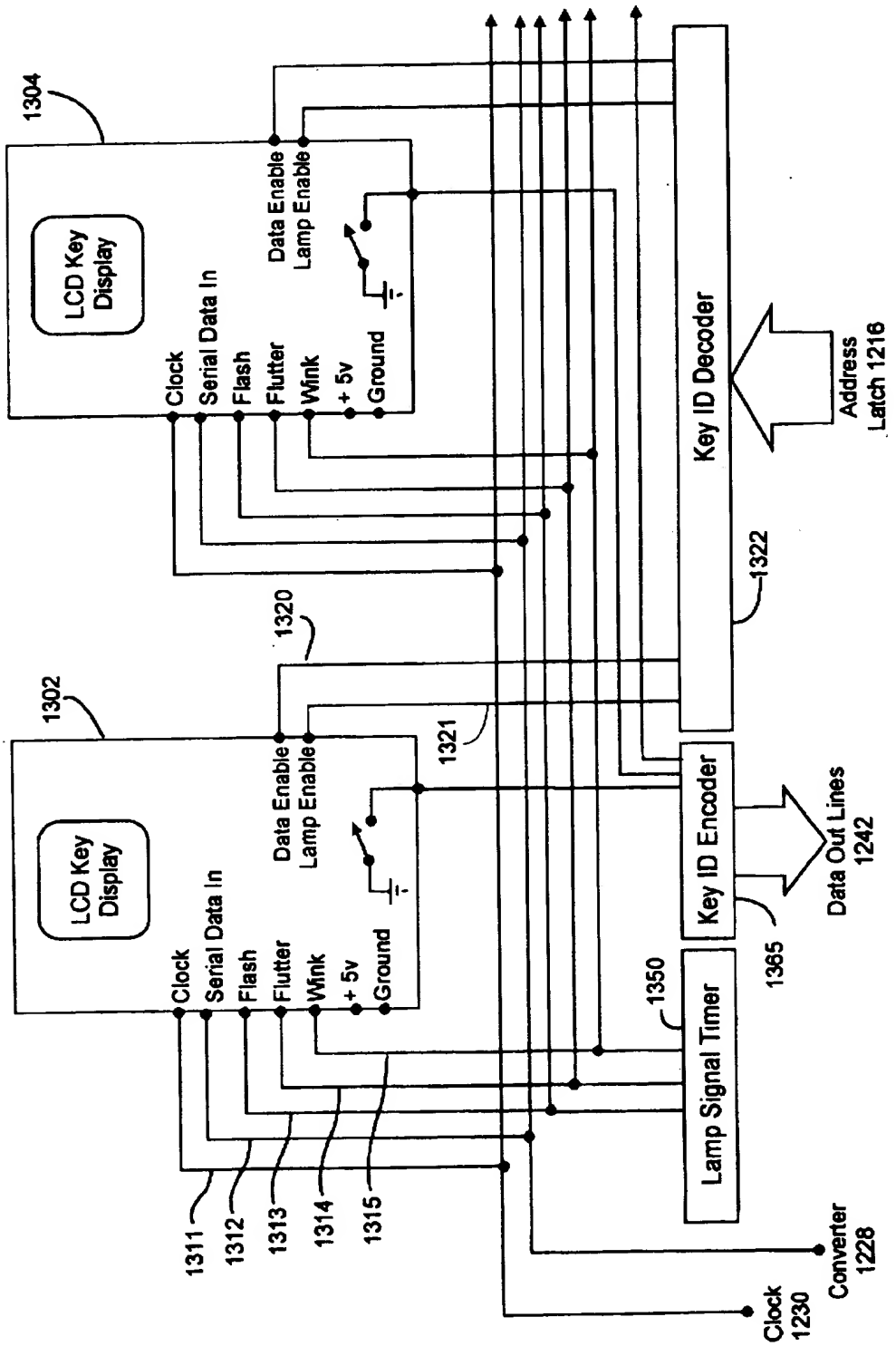

1304
LCD Key Display
Clock
Serial Data In
Flash
Flutter
Wink
+ 5v
Ground
Data Enable
Lamp Enable
1320
1302
LCD Key Display
Clock
Serial Data In
Flash
Flutter
Wink
+ 5v
Ground
Data Enable
Lamp Enable
1321
Key ID Decoder
Address Latch 1216
1322
Key ID Encoder
Data Out Lines 1242
1365
1350
Lamp Signal Timer
1311
1312
1313
1314
1315
Converter 1228
Clock 1230

Fig. 13

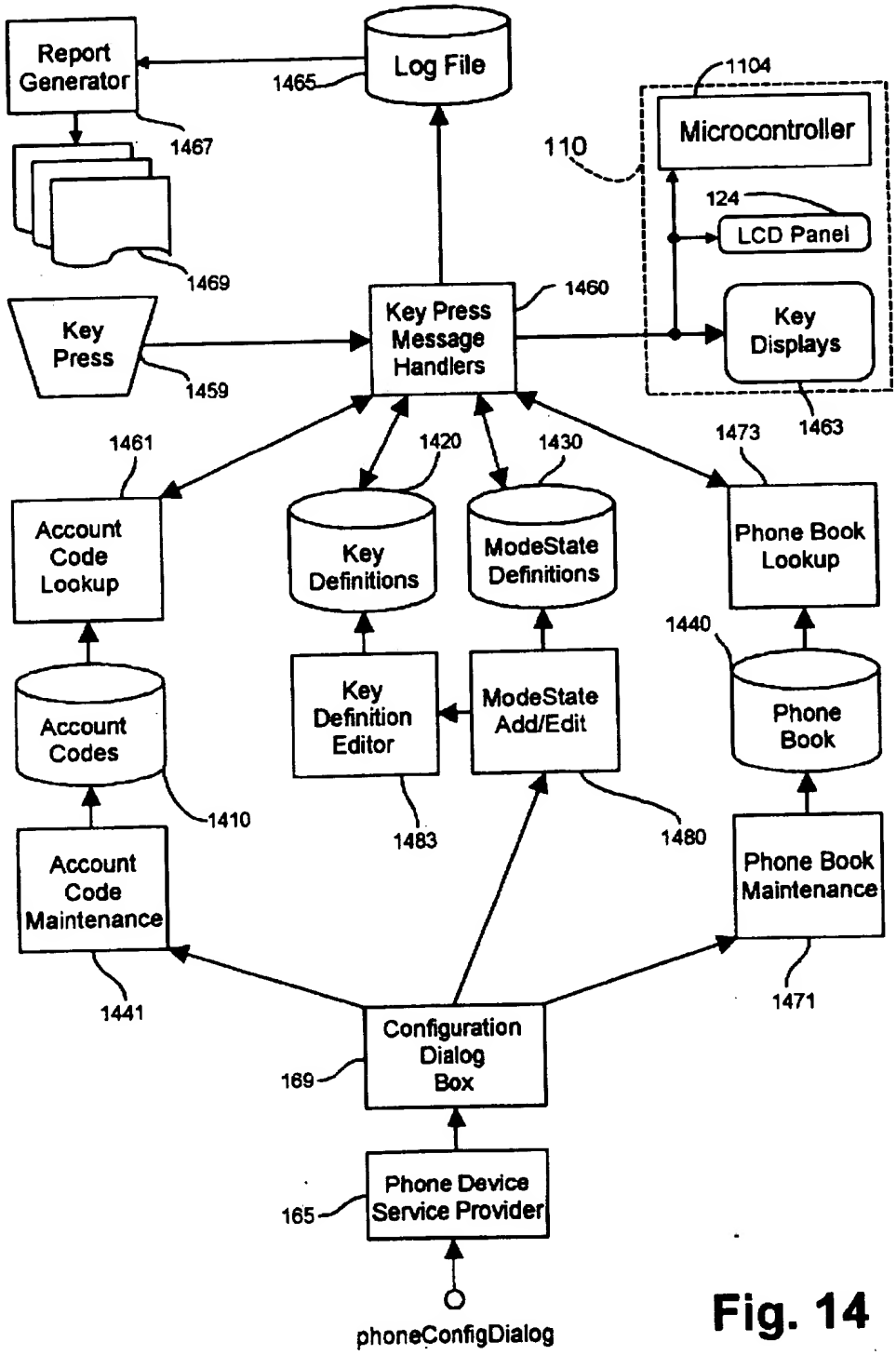

Report Generator
1467
1469
Log File
1465
1104
Microcontroller
110
124
LCD Panel
Key Press
1459
Key Press Message Handlers
1460
Key Displays
1463
1461
1420
1430
1473
Account Code Lookup
Key Definitions
ModeState Definitions
Phone Book Lookup
1440
Account Codes
1410
Key Definition Editor
ModeState Add/Edit
Phone Book
1483
1480
Account Code Maintenance
1441
Phone Book Maintenance
1471
Configuration Dialog Box
169
Phone Device Service Provider
165
phoneConfigDialog

Fig. 14

TELEPHONE STATION EQUIPMENT EMPLOYING REWRITEABLE DISPLAY KEYS

FIELD OF THE INVENTION

This invention relates to telephone communications and more particularly to terminal equipment operated by a user to obtain a variety of telephone services.

BACKGROUND OF THE INVENTION

In recent years, computer-based telephone management systems have been developed in which the computer itself provides the human interface to the telephone system. Such systems typically offer a host of services which replace or supplant the services provided by conventional, standalone telephone terminal equipment such as telephone station sets and facsimile machines. By adding suitable software and interface hardware, such as a data/voice/fax modem, an existing personal computer can be readily converted into a powerful communications tool for establishing conventional voice lines and for sending and receiving facsimile images and data files. Frequently, when the personal computer is coupled to a local area network, shared communications facilities can be made available via the network, eliminating the need for additional telephone interface hardware at each personal computer.

While robust telephone management and communications functions can be provided using the personal computer as the telephone terminal, users have found these systems to be difficult to use. Thus, while a given personal computer telephone management system might include a stored database of telephone numbers which can be activated and then manipulated using the computer keyboard or the mouse to select and automatically dial a desired telephone number, it is often faster and easier to simply look the number up in a published directory and then manually dial the number in the usual way. As software developers add an ever expanding set of features to such computer telephone management systems, such systems necessarily become more complex and more difficult to use, particularly for functions with are infrequently invoked.

SUMMARY OF THE INVENTION

It is a leading object of the present invention to make telephone station equipment easier to use by incorporating a special telephone keypad whose operation mimics the push-button telephone keypad familiar to nearly everyone, with each key incorporating a small, writable graphic display panel that reveals that key's function or supplies relevant information to the user. The keypad is connected to a control computer which responds to each key press, performing desired functions and selectively altering the information displayed by each key to prompt the user with a changing set of available choices.

In one preferred embodiment, the present invention utilizes a novel phone device which includes a conventional telephone handset consisting of a mouthpiece microphone and an earpiece speaker, a hook switch for connecting and disconnecting the handset and the line circuit, and a manually manipulatable keypad consisting of a plurality of display keys, each of which incorporates sensing means for detecting the actuation of the key by a user and a display panel for visually presenting information to the user.

A programmed computer, which may advantageously take the form of a conventional personal computer, is

provided with a keypad interface circuit for transmitting key press signals indicative of the actuation of the keys to the computer and for transmitting display information from the computer to the individual key displays. A control program responsive to key press signals performs functions which are visually indicated by the various display keys, and alters the key displays to reflect the current state of the particular task being performed.

Telephone functions may be easily and intuitively selected solely by viewing and manipulating the display keypad. The keys may be used to perform conventional dialing, redialing, speed-dialing from a directory of commonly called numbers, perform flash disconnection, forward calls, control call waiting functions, adjust speakerphone volume and microphone gain control, handle conference calls, automatically log into remote databases, record each call in an accounting file, perform unattended call answering and voice mail functions, integrate voice responsive and automated voice output systems, and more, using the display keypad alone to select and activate each function.

To facilitate these and other telephone management functions, the display keypad on the phone device is preferably integrated with one or more computer control programs using an industry standard application program interface (API), permitting the novel phone device to be used to create, control and manage telephone connections required by any application program which supports the shared standard API.

These and other objects, features and advantages of the present invention will be better understood by considering the following detailed description of a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the description which follows, reference will frequently be made to the attached drawings in which:

FIG. 1 is a block diagram illustrating the relationship between the principle components of the preferred embodiment of the invention;

FIG. 2 is a control flow diagram illustrating the manner in which key press operations are processed by the supervisory control program used to implement the invention;

FIGS. 3–10 illustrate eight keypad displays utilized in connection with eight corresponding mode states of the phone device;

FIG. 11 is a logical block diagram of the phone device used to implement the invention;

FIG. 12 is a block diagram of one embodiment of the interface circuit utilized in the phone device of FIG. 11;

FIG. 13 is a logical block diagram illustrating the interconnections between the LCD keyswitches and the LCD keyswitch driver circuits utilized in the phone device of FIG. 11; and

FIG. 14 illustrates the data file mechanism and program flow control used in the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates the relationship between the principal hardware and software components of the preferred embodiment of the invention. As seen in FIG. 1, a personal computer 100 is connected via telephone subscriber line 102 to a telephone service central office 104. Computer 100 is further connected to a phone device 110 by an interface connection 112.

The phone device **110** includes a handset **114** which houses an earpiece speaker **116** and a mouthpiece microphone **118**. When not in use, the handset **114** rests on the housing of the phone device **110**, engaging a hookswitch illustrated at **120** to place the phone device in an "ON HOOK" state in the conventional fashion. A liquid crystal display panel **124** and a keypad **126** are mounted on the exterior face of the phone device **110**. The display **124** is capable of displaying up to twenty-four alphanumeric characters which are transferred as a character data stream to the phone device **110** via the interface connection **112**.

The keypad **126** preferably comprises twelve display keys arranged in the conventional telephone keypad matrix consisting four rows with three keys per row. A key actuation signal is sent to the personal computer **100** via the interface connection **112** whenever any of the keys in the keypad **126** is pressed or released. Each key in the keypad **112** incorporates a backlit liquid crystal display (LCD) panel which is capable of displaying a graphical or alphanumeric image, the image being transferred to the key via the connection **112** as a block of pixel image data generated and transmitted by the computer **100**. In addition, the backlighting of each key's LCD display panel is selectively controlled by backlight command signals supplied to the phone device **110** via connection **112** such that the backlighting may be turned OFF, or turned ON in a selected color (e.g. white, green or red).

The phone device **110** is further provided with a distinctive ringing device (not shown in FIG. **1**), a loudspeaker indicated at **130**, and a pickup microphone seen at **132**. The loudspeaker **130** and microphone **132** permit the phone device **110** to operate as a speakerphone. Control commands sent from the computer **100** via connection **112** are employed to independently control the volume of sound delivered by the loudspeaker **130** and the volume of the sound produced by the earpiece speaker **116** in handset **114**. Similarly, control commands sent via connection **112** independently control the gain of the pickup microphone **132** and the mouthpiece microphone **118**.

Circuitry on a hardware expansion card **140** is used to establish communications between the computer **100** and the telephone line **102** and between the computer and the phone device **110** via the interface connection **112**. The expansion card **140** plugs into a standard I/O system bus hardware interface slot seen at **150** to establish connections with the data, address and control lines of the personal computer **100**. As discussed in more detail below, the embodiment of the invention described herein is adapted for use with personal computers typically employing the Intel 386, 486 and Pentium processor families capable of implementing the Windows 95 and Windows NT operating system distributed by Microsoft Corp. Accordingly, the expansion card **140** is preferably adapted to mate with and communicate with a system bus slot configured in accordance with the ISA or EISA (16 bit) or the PCI bus (32 bit) interface standard commonly used in computers of this class. Specifications and complete descriptions for each of these industry standard bus configurations may be found, for example, in Chapter 5, "Bus Slots and I/O Cards", *Upgrading and Repairing PCs*, 5th Edition, by Scott Mueller, Que Corp., Indianapolis, Ind. (1995), ISBN 0-7897-0321-1.

The expansion card **140** preferably includes a data/fax/voice modem unit **144** of conventional design. The modem unit **144** preferably provides modem data transmission at 28.8K bps employing the CCITT modem protocols V.34; V.Fast Class; V.32 terbo; V.42 bis; V.42; V.32 bis; V.32; V.22 bis; and V.22, supports the MNP 5 error correction/data compression protocols, and the Hayes AT command set for line control, including autodial support. The modem **144** additionally provides send/receive FAX modem document transmission at 14.4K bps using the CCITT Group 3 Fax protocol (V.17). Available internal expansion cards which provide such industry standard data/fax/voice capabilities over dialup telephone facilities are available commercially as exemplified by the *Courier V.Everything with V.34 PC modem* sold by U.S. Robotics Corp., 8100 N. McCormick Blvd., Skokie, Ill. 60076-2999 and the *Optima* 288*I V.34/V.FC+FAX modem* sold by Hayes Microcomputer Products, Inc., PO Box 105203, Atlanta, Ga. 30348, both of which are compatible with the 16 bit ISA I/O bus. The conventional data/voice/fax modem **144** typically includes a telephone line control mechanism for performing pulse and dial tone (DTMF) dialing, data compression and error correction, data transmission flow control and protocol support, transmission speed control, and transmission control.

As seen in FIG. **1**, the modem unit is connected to the dialup telephone line **102** by a standard telephone jack **146** which is cross-connected with an auxiliary telephone jack **147** which permits other telephone station equipment to be connected to the telephone line **102**. The interface connection **112** to the phone device **110** is connected to the expansion card **140** by means of a standard 25-line PC parallel port connection **148** which includes power, bidirectional data lines, control lines, and lines directly connected to the telephone lines **102**. See Chapter 11, "Communications and Networking," *Upgrading and Repairing PCs*, cited above, for pin assignment specifications for the standard parallel port interface. The display keys in the keypad **126** receive display data via 8 bit parallel data output lines of the connection **112**, and the 8 data input lines of the connection are used to pass key press signals from the phone device and to provide circuit paths for the telephone line circuit **102** (tip and ring lines) which are directly cross connected between the phone jack connectors **146** and **147** and the telephone circuit lines of the interface connection **112** at the **25** pin socket **148**. This direct cross-connection allows to phone device to operate as a conventional telephone when the computer **100** is powered down. To this end, the phone device may advantageously be provided with a conventional auxiliary touch-tone keypad (not shown) in the handset **114** and an associated dial tone generation circuitry, permitting incoming calls to be dialed manually at the handset, even when the computer **100** is inoperative. Alternatively, the display key switches in keypad **126** may be interconnected with a dial tone generator for generating dial tones when the computer **100** is powered down and unable to produced dialing signals using the modem **144**. Similarly, the phone device **110** includes a ringing circuit (not shown) for providing audible ringing in response to the appearance of ringing signals on the telephone line circuit **102** when the computer **100** is inoperative and, as discussed later, for providing ringing signals at the phone device in response to ringing commands from the computer **100**.

Software

The personal computer **100** includes a conventional mass storage subsystem (not shown), typically a magnetic "hard" drive, which provides persistent storage for program files which are loaded into the computer's random access memory for execution by the processor. These program files are loaded by the operating system to form concurrently resident, interactive modules illustrated in block diagram form in FIG. **1**. These modules include:

a supervisory control program seen at **162** which functions as an application program automatically loaded

during system startup and thereafter continuously resident as an active, although typically dormant, process as long as the computer **100** is powered up in order to support the operation of the phone device **110**;

a telephone application program interface library **164**, such as the TAPI dynamic link library (DLL) which forms part of the Windows 95 operating system marketed by Microsoft Corp., Redmond, Wash.;

a phone device service provider dynamic link library **166** which operates as a hardware device driver providing interface routines which provide communications between the phone set hardware interface circuit **142** and the TAPI DLL 164;

a line device service provider dynamic link library **167** such as the UniModem SPI included as part of Windows 95 which provides a device driver interface between the data/voice/fax modem **144** and the line device service provider interface (Line Device SPI) **168** defined by the TAPI DLL 164;

a configuration dialog box routine **169** which may be invoked by the phone device SPI DLL **165** when the supervisory control program or any other running application program such as application program **170** requests the user to provide configuration information by making passing a request for the configuration dialog box via the TAPI DLL 164 and the phone device service provider **165**; and

one or more additional application programs illustrated by the program **170** which offers telephone management services utilizing the services provided by the TAPI DLL.

The supervisory control program **162** preferably communicates with the modem **144** and with the phone device interface circuit **140** using a standard interface protocol such as the *Telephony Application Program Interface* (TAPI) jointly developed by Microsoft Corp. and Intel Corp. Alternatively, the *Telephony Services Application Program Interface* (TSAPI) promulgated by Novell, Inc. and others may be similarly employed to provide substantially the same functionality. The embodiment of the invention, as described in more detail below, employs the TAPI interface implemented in Microsoft's Windows 95 operating environment and described in detail in the *Microsoft WIN32 System Development Kit* (SDK), "Telephony Application Programming Interface (TAPI)", published as part of the *Microsoft Development Library* by Microsoft Corp., Redmond, Wash.

The supervisory control program **162** takes the form of a WIN32 application program which functions in accordance with the software design specifications set forth in the *Microsoft Win32 Programmer's Reference* (1995), published by Microsoft Corp., which fully describes the elements of the Win32 application programming interface (API), including functions and related data types, macros, structures, and messages. The *Win32 Programmer's Reference* is the definitive source for specific information defining the makeup of Win32-based applications.

As described in more detail below in connection with FIG. 2, supervisory control program **162** controls the operation of the modem **144** and the phone device **110** by responding to Windows messages relating to telephone management operations, by making function calls to the TAPI.DLL 164 which forms part of the Windows 95 operating system, and by incorporating callback functions which respond to function calls from the TAPI.DLL 164. The *Win32 Telephony (TAPI) Programmer's Reference* (1995), published by Microsoft. Corp., defines the Microsoft Windows Telephony application programming interface (API) which provides services that enable an application developer to add telephone communications to applications developed for the Microsoft Win32 (API). Additional information, including example programs illustrating the mechanism used by application programs to implement telephone functions using TAPI are described in the article "Tapping into TAPI", by Nancy Winnick Cluts, *Microsoft Developer Network News*, Vol 4. No. 6 (November–December 1995); "Creating a TAPI Connection Using CtapiConnection," by Nancy Winnick Cluts, *Microsoft Developer Network News*, Vol 5. No. 1 (January 1996); and "Developing Applications Using the Windows Telephony API," by Toby Nixon, *MSDN Conferences/Tech*Ed 1994/Microsoft At Work* (1994).

The supervisory control program **162** is preferably loaded at system startup time when the Windows 95 operating system is initialized. As is in all Windows 95 application programs, the supervisory control program **162** and includes, in its main routine, message loop which repetitively calls the WIN32 function GetMessage. The control program **162** operates in background and its sole purpose is to execute code in response to window messages posted to the program thread's message queue. If there are no pending messages, the operating system puts the thread to sleep and no longer schedules CPU time to the thread. When a message appears in the thread's message queue, the system wakes up the thread, GetMessage copies the message from the queue into the &msg variable and Windows then executes the function DispatchMessage to pass the message data to the window procedure of the control program **162**.

The mechanism used by TAPI to notify applications of events is based on function callbacks, and TAPI defines the parameter profile for these callbacks. When an event occurs, the application's callback function is invoked from within the application's thread (at the time the application calls the GetMessage function), providing a normal, fully functional execution environment in which all Windows APIs can be safely invoked. To perform operations which must be handled asynchronously, TAPI provides a reply callback mechanism. The reply callback made to the application carries the request ID and an error indication. Valid error indications for this reply are identical to those that are returned synchronously for the associated request, or zero for success. Only the application that issued the request will receive the reply callback, but when the request causes changes in the state of the device or call, other interested applications may also receive event-related messages. TAPI guarantees that a reply callback is made for every request that operates asynchronously, and it defines which functions are notified synchronously and which are notified asynchronously.

Messages transmitted to the application from TAPI utilize the application-supplied callback function, lineCallbackFunc, in the application's context. When an application makes the TAPI function call lineInitialize or phoneInitialize, it specifies a callback function by passing its pointer as a parameter. The callback message always contains a handle to the relevant object (phone, line, or call). The parameter profile for callbacks contains a multi-purpose handle parameter which is used for passing a handle to the relevant phone, line, or call. The callback function can determine the type of the handle from the message that was passed to the callback. Certain messages are used to notify the application about a change in an object's status. These messages provide the object handle and give an indication of which status item has changed. The application can call the appropriate "get status" function of the object to obtain the object's full status.

Messages from TAPI which represent line device events (events characterizing the status and functioning of the modem **144** and the telephone line **102**) are produced by the UniModem line device service provider **167**. Similarly, phone device events characterizing the status and functioning of the phone device **110** are produced by the phone device service provider **140**. Both of these service providers operate as device drivers which support the TAPI SPI for communication of hardware events and signals to the TAPI DLL via the TAPI line device SPI and the TAPI phone device SPI. Detailed information on the structure and operation of Windows 95 device drivers generally is contained in *The Device Driver Programmer's Reference*, Microsoft Corp. (1995) which details the structure and operation of Windows-based device drivers for use with Microsoft Windows 95. Microsoft *Windows 95 Device Driver Development Kit*, Microsoft Corp. (1995), provides additional detail and examples used to implement device drivers generally, and specific information on the makeup of line device driver routines suitable for interfacing a robust voice/data/fax modem with the TAPI SPI may be found in the *Windows 95 Modem Development Kit (MDK)*, Microsoft Corp. (1995), which provides the tools, sample INF files, and information needed to build and test the Windows 95 format INF files for AT (data) and AT+V (voice) command modems. Windows 95 INF files are required for modems to be used by programs which call the Windows Telephony API (TAPI) to make data/fax/voice calls, including the Windows 95 applets HyperTerminal, Dial-up Networking, Phone Dialer, and other Win32 communications applications written for Windows 95.

The preferred embodiment of the invention seen in FIG. **1**, as noted above, may employ a commercially available data/voice/fax modem **140** as well as a conventional line device service provider DLL **167**. It should be understood however that the TAPI line services may be provided by other conventional means, such as a high speed ISDN connection, a network interface to a shared modem or PBX, and the like, in ways that are essentially transparent to the operation of the phone device **110** and the supervisory control program **162**. The line device service provider **167** may accordingly take the form the universal modem driver (UniModem) supplied as part of Windows 95, an operating system layer that cooperates with TAPI to provide services for data and fax modems and voice so that users and application developers need not deal with difficult modem AT commands to dial, answer, and configure modems. Rather, UniModem does these tasks automatically by using mini-drivers written by modem hardware vendors and made available, for most modems, as a part of Windows 95 or supplied separately by the modem vendor. UniModem is both a VCOMM device driver (supporting DOS legacy programs) and a TAPI service provider. Other service providers (for example, those supporting other devices, such as an ISDN adapter, a telephone on a PBX system, or an AT-command modem) can also be used with TAPI and thereby made available for use by the phone device **110**.

The phone device service provider **165** similarly operates as a WIN32 device driver but performs a more limited set of functions in support of the TAPI phone device interface built in functions and protocols for handling all of the following elements:

Hookswitch/Transducer. The Windows 95 Telephony API recognizes that a phone device may have several transducers, which can be activated and deactivated (taken offhook or placed onhook) under the control of an application (e.g. the supervisory control program **162**) or manual user control. TAPI handles the two types of hookswitch devices present in the phone device **110**: the handset **114**, a traditional mouth-and-ear piece combination that must be manually lifted from the hookswitch **120** and held against the user's ear, and the speakerphone formed by the combination of loadspeaker **130** and pickup microphone **132**, enabling the user to conduct calls hands-free. The hookswitch state of the phone device **110**'s speakerphone can be changed both manually and by the supervisory control program **162** in response to the depressing of display keys in the phoneset.

Volume Control/Gain Control/Mute. Each hookswitch device is the pairing of a speaker and a microphone component. The TAPI API provides for volume control and muting of speaker components and for gain control or muting of microphone components.

Ringer. A means for alerting users, usually through a bell. The phone device **110** preferably includes a ringing annunciator which rings in a variety of modes or patterns to provide distinctive ringing determined by commands from the control program **162** and transmitted via TAPI to the ringing circuitry in the phone device **110**.

Display. The LCD display panel **134** seen in FIG. **1** for visually presenting messages to the user is supported by the TAPI display functions. A TAPI compliant phone display is characterized by its number of rows and columns. In the illustrative embodiment described here, the display consists of a single LCD panel **124** for displaying a single, 24 character alphanumeric string passed via the TAPI display interface from the control program **162**.

Buttons and lamps. The TAPI button interface is used to support the array of twelve backlit display keys in the keypad **126**. Whenever the user presses a button on the keypad **126**, TAPI reports that the corresponding button was pressed to the application program (e.g. the supervisory control program **162**). TAPI button-lamp IDs identify a button and lamp pair. The white backlighting source in each button is treated as the lamp associated with the associated physical keypad button which to form one such TAPI "pair." TAPI also accommodates button-lamp pairs with either no button or no lamp, and hence two sets of twelve "buttonless" pairs are used to handle the green and red backlighting sources for the display keys. The backlighting lamps are hence individually controllable from the API and can be lit in different modes by independently varying the on and off frequency of each of the three backlight lamp colors (white, red and green) to provide Off, flashing, flickering or flash-flickering modes for each. This mode and color control enables special visual effects to be employed to direct the user's attention to special features and functions. Each lamp, color and mode can be independently set using the TAPI button-lamp ID to identify the lamp being controlled.

Data Areas. TAPI further accommodates the loading of addressable memory areas in the phone device. Normally used in TAPI environments for storing phone device instruction code or data that can be downloaded to and/or uploaded from the phone device, the present invention also utilizes this TAPI data movement mechanism to transmit the individual display key bitmaps from the control program **162** to the display keys in keypad **126** as described in more detail below.

In addition to the utilization of TAPI as noted above for the communication of control commands from the application program (e.g. control program **162**) to the phone device **110**. TAPI is also used to transmit information concerning the actuation of keys on the keypad to the application program. When a button is pressed, a PHONE_BUTTON message is sent to the application's callback function. The parameters of this message are a handle to the phone device and the button-lamp ID of the button that was pressed. The keypad buttons (normally labeled '0' through '9', '*', and '#') are assigned the fixed button+white lamp IDs **0** through **11**. These button messages indicate when a button is pressed and when it is released, enabling the supervisory control program to maintain a software status indication for each button, permitting the control program to recognize and respond to two or more buttons to be pressed simultaneously to create special effects, in the same way that simultaneous key presses on a computer keyboard may be assigned special significance.

The supervisory control program **162** responds to each key press operation as illustrated in FIG. **2**. Each keystroke operation performed by the user using the keypad **126**, indicated at **202** in FIG. **2**, sends a PHONE_BUTTON message to the callback function **204** of program **162**. The callback function **204** evaluates the incoming message, setting that switch status variable associated with the button ID identified in the incoming message to a value determined by whether the message indicates that the button has been pressed or released. Messages indicating that a button have been pressed are then passed to message routing function **206** which calls a particular message handling function in accordance with the current value of the modestate variable stored at **208**.

The modestate variable **208** contains one of a predetermined set of ordinal values each of which indicates a particular machine state. A message handling function is associated with each state. FIG. **2** shows eight such functions, by way of illustration, at **211–218**. Each mode function **211–218** interprets and responds to the keypress signals from keypad **126** when the machine state is in a particular mode. Thus, when the modestate variable is in MAIN mode, each incoming PUSH-BUTTON message is routed to the MAIN message handling function **211**; when the modestate is MANUAL, the routing function passes the PHONE_BUTTON message as a parameter to the MANUAL message handling function **212**, and so on.

In many cases, a message handling function will respond to a particular button press by switching mode states. Mode state changes are accomplished by (1) setting the modestate variable **208** to a new value, thereby changing the routing of incoming messages; (2) sending a new set of button graphics displays and backlight lamp settings to the keypad **126**; and (3) sending a new alphanumeric string for display by the LCD panel **124**. Illustrative button and LCD displays are shown in FIGS. **3–10** of the drawings which show the button graphics and alphanumeric displays used for each of the eight illustrative modestates and their corresponding message handling functions as set forth in the table below:

Button Display	ModeState Description	Message Handler
FIG. 3	Main (idle state)	211
FIG. 4	Manual Dialing	212
FIG. 5	Recently Called Parties	213
FIG. 6	Directory Level 1	214
FIG. 7	Directory Level 2	215
FIG. 8	Directory Level 3	216
FIG. 9	Call Waiting Setup	217
FIG. 10	Call in Progress	218

When the supervisory program is initialized it places the phone device in the MAIN ModeState. Moreover, if the system is idle, as indicated by a predetermined elapsed time with no key press activity, the supervisory program **162** automatically returns the phone device to the MAIN (idle) ModeState.

Each time the supervisory program places the phone device into any new ModeState, it performs at least the following actions:

(1) the ModeState variable is set to a new value indicating the new mode state such that, thereafter, all PHONE_BUTTON messages will be routed to the appropriate modestate message handling routine **211–220**.

(2) a new alphanumeric string is transmitted to the display **124** seen in FIG. **1**. TAPI provides access to a phone's display which is rewritten using the function call phoneSetDisplay to write information to the display **124** of the open phone device **110**.

(3) a new set of twelve bitmaps is sent to the twelve key displays in the keypad **124**. The Telephony API models a phone device as having one or more download or upload areas. Each area is identified by a number that ranges from zero to the number of data areas available on the phone minus one. Sizes of each area may vary and he format of the data itself is device-specific. In the illustrative embodiment, twelve download areas are reserved for monochromatic bit maps, with each bit indicating whether a given pixel is ON or OFF. Key display resolutions of 32×16 (512) bits provide sufficient resolution to provide meaningful function identifications, however more descriptive information, such as the names of parties to be called which are displayed in a speed dialing directory as discussed later, can be provided using a larger bitmap. In the examples that follow, a 64×64 bit display is assumed, requiring that a 4096 bit (512 byte) TAPI download area be designated. The TAPI phoneSetData function downloads a buffer of data to a given data area in the phone device. The twelve bitmaps for each modestate are stored in two dimensional array indexed by the modestate value and the button number 0–11. When a new modestate is entered, the supervisory control program calls phoneSetData twelve times to pass the bitmaps for the twelve keys associated with the new modestate to the keypad **126**.

(4) The backlighting of each key is also reset whenever a new modestate is entered using the TAPI phoneSetLamp, which lights a lamp on a specified open phone device in a given lamp lighting mode. TAPI supports the following lamp mode specifications:

PHONELAMPMODE_OFF—the lamp is off.;

PHONELAMPMODE_STEADY—the lamp is continuously lit.;

PHONELAMPMODE_FLASH—"Flash" means slow on and off;

PHONELAMPMODE_FLUTTER—"Flutter" means fast on and off;

PHONELAMPMODE_BROKENFLUTTER—"Broken flutter" is the superposition of flash and flutter; and

PHONELAMPMODE_WINK—the lamp is winking.

FIG. 3 shows the bitmap displays presented in an illustrative MAIN (idle) mode. In FIGS. 3–10, the alphanumeric display presented by the LCD display 124 is shown immediately above the 12 key bitmap displays. In the MAIN modestate, the LCD display shows the current date and current time of day which is updated every minute by a timer routine in the supervisory control program which obtains the date and time from the system, constructs and formats the display string, and sends the resulting string to the display using the TAPI function call phoneSetDisplay.

In the MAIN modestate, the twelve buttons on the keypad display the bitmaps illustrated in FIG. 3 and all PHONE_BUTTON messages received from TAPI are routed to the MAIN routine seen at 211, which operates as follows when the respective button numbers 0 through 11, are identified:

Button 0 pressed: Manual dialing is request ed the system is placed in the MANUAL modestate, resulting in the display seen in FIG. 4 being displayed and all PHONE_BUTTON messages thereafter being processed by the MANUAL message handler 212;

Button 1 pressed: The user requests that the most recently dialed number be redialed. Each dialed number is saved by the supervisory control program is saved in a dialable phone address string variable LAST_DIALED which is passed to TAPI using a lineMakeCall or LineDial function call. The modestate is then switch ed to the INPROGRESS mode (FIG. 10) and the display 124 is sent a string containing the concatenated combination of "Dialing" and the LAST_DIALED string variable to overwrite the default display message created when the INPROGRESS mode was entered.

Button 2 pressed: The user requests a display of the most recently dialed numbers, which is accomplished by entering the PREVIOUS modestate whose display is illustrated in FIG. 5. As calls are established, they are stored in a most-recently-used stack in a persistently stored database by the supervisory control program 162 with the nine most recent called parties being displayed as shown in FIG. 3. One of the most useful features of the invention is its ability to visually associate the identification of a callable party with a key. As illustrated by FIGS. 3 and five, the task of redialing a selected one of the nine most recently called numbers involves only two keypresses, first pressing the key labeled "Redial Prev." which then displays the nine most recently called parties on keys, and then pressing the key for the desired party, without any need to touch a computer keyboard, start a particular telephone management program, or manipulate window objects with a mouse. No computer skills are required and small children can readily understand and use the system in a completely familiar and intuitive way.

Button 3 pressed: The user requests access to a multi-level phone book which takes the form of a conventional relational database (not shown), persistently stored in the computer 100 and accessed by the control program 162. Pressing Button 2 labeled "Phone Book" sets the modestate to LEVEL_1 to create the display seen in FIG. 6 and route ensuing PHONE_BUTTON messages to the Level-1 message handling routine 214. In the LEVEL_1 mode, the user can select between a variety of subdirectories, illustrated in FIG. 6 as consisting of button selectable sub-directories of (1) local numbers within a business establishment arranged alphabetically, (2) the same local numbers organized by work group, (3) outside phone numbers organized alphabetically by the last name of the callable person, (4) outside number organized alphabetically by firm name, (5) outside phone numbers organized alphabetically by geographical location. When a button is pushed to select a subdirectory organized which is organized alphabetically, the control program 162 first executes a subroutine which consists of sending a keypad display of the type seen in FIG. 7 to the keypad to obtain a selection from the user identifying an alphabetic subsection of the phone book database directory. As an example, if the user wishes to call a person outside the organization named "Alice Brookstone", the "Phone Book" key would be pressed first in the MAIN modestate presenting the display of FIG. 6. Then, the user would press the button marked "Outside be Name" to produce the display of FIG. 7. Next, the button marked "ABC" would be pressed to produce an listing of callable parties displayed alphabetically by last name, as illustrated in FIG. 8, which includes a button bearing the display "Alice Brooksn" (shortened to fit into the 64×64 bit display). Pushing that button would place the call to her phone number in the manner indicated earlier and further place her identification in the stack of recently called parties as well as in the LAST_DIALED variable discussed earlier to make her name and number available using the MAIN mode "Redial Last" and "Redial Prev." buttons.

Button 4. By pressing the "Bill To" button in the MAIN modestate, the user can use a database lookup function similar to the phonebook lookup procedure indicated above to identify a particular billing account to which future calls should be billed. When button 4 is pressed in MAIN mode, the phone device is reset to the BILLTO modestate and a lettercode grouping display as shown in FIG. 7 is shown on the keypad, except that the LCD display shows the current account selected with a display such as "Bill To Ajax. Corp." If the user determines that the current setting is correct, the "Main Menu" or "Back" keys can be pressed to return the system to the MAIN modestate. Note that, to provide a consistent interface to the user, three functions always appear in the same positions on the keypad: "MAIN MENU" (for resetting the system to its MAIN modestate), "BACK" (for returning the system to the modestate that called the present state, which may or may not be the MAIN modestate), and "NEXT" for calling a modestate which is, in effect, contains additional options and forms, in effect, an extension of the present state). In the case of lookup functions such as those implementing the "phone book" and "bill to" selections, the "NEXT" key operates to continuously step through a given directory level, nine items at a time, returning to the first items when the end of the directory level is reached. To implement the accounting functions, the supervisory control program appends a record to an accounting file each time a call is completed, recording the identity of the party with whom the communication took place, the starting and ending time of the call (from which its duration may be determined for billing purposes), and the identification of the account (selected using the Bill To key sequence described above) to classify the call. Actual billing reports are then produced at any time by reading the data stored in the accumulated accounting file.

As illustrated by the foregoing examples, the present invention permits substantially any telephone management function to be activated by an inexperience user by simply pressing buttons labeled to indicated the desired functions. As illustrated in the display seen in FIG. 3, these functions may additionally include call waiting setup controls, voice mail, call forwarding control, speakerphone activation and control, database logon functions, and more.

In addition, as illustrated in FIG. 8, the display keypad and LCD may be used to control the handling of a call in progress when the system is in the INPROCESS modestate.

Pressing the "Flash" button seen in FIG. 8 causes the CallProgress message handler 218 to terminate the present connection by calling the TAPI function lineDrop to obtain a new dialtone and reset the system to its MAIN modestate to permit a new call to be initiated. Pressing the "Hold" button suspends the present call without loosing the connection and, if additional lines are available through, allows another conversation to proceed concurrently.

Note that the capabilities of the TAPI DLL included with the operating system permit a plurality of different lines to be active simultaneously and allow a give phone device to be programmatically "connected" with an such logical line. Similarly, the display keypad control mechanism contemplated by the invention may be used to particular advantages to control "Supplementary Services which are defined by the Telephone SPI, but not included in the basic telephony subset. These services include all so-called supplementary features found on modern PBXs including hold, transfer, conference, park, etc. Depending on the capabilities of the line device services which are connected in a given setting, the present invention can control these services through the TAPI DLL, and can query a line or phone device for the set of supplementary services it provides. Note that a single supplementary service may consist of multiple function calls and messages."

Finally, as illustrated by the use of the keypad for controlling speaker volume and microphone gain, and the control information displayed by the LCD panel 124, any of the instrumentalities within a phone device can also be controlled by sending button messages from the display keypad through TAPI to the control program and sending control commands from the control program via TAPI to the phone device. As discussed below in connection with FIG. 11, the phone device itself may contain a programmable microcontroller for controlling the operations of the phone set, and the TAPI interface is commonly used to download specific instructions and commands from the computer to the phone device to implement specific phone device functions. It is important to recognize, however, that the phone device contemplated by the invention provides its own user interface, even though it may call upon the processing service of the connected computer. The phone device of the present invention is designed to mimic the operation of a conventional telephone set during normal operation, as well as to retain all the functionality of a conventional telephone set in the event of a power outage or the failure of a component in, or controlling, the LCD keypad.

Although the supervisory control program operates in the background, requires no attention from the user, and does not require a user interface window on the display screen of the computer 100, a configuration dialog box, callable by the phone device service provider 165 provides a mechanism for obtaining information from the user and displaying information to the user by way of the computer 100. Just as the TAPI API function lineConfigDialog allows a running application program to request the invocation of a dialog box (not shown) supplied with the line service provider DLL, such as UniModem, the TAPI function phoneConfigDialog causes the phone device service provider 165 to display a dialog box (attached to hwndOwner of the calling application) to allow the user to view and configure parameters related to the phone device. The phone device dialog box seen at 169 may be called from the computer 100 in response to a request from the supervisory control program when the user uses the mouse to "right click" on the service providers' minimized icon in the usual fashion to display a popup menu which includes a "Configure" option. Alternatively, a display key on the phone set may display the prompt "Config." in a suitable modestate, and the supervisory program can then respond to the actuation of that key by invoking the phoneConfigDialog TAPI function.

The configuration dialog box 169 may be advantageously employed to display bitmap, directory and billing database maintenance routines, provide a mechanism for identifying and incorporating graphic bitmap files with text to form the downloadable bitmaps for each key in each modestate, and so on. In this way, the functions of the phone device may be programmably configured from either the supervisory control program or from any other telephone management program (illustrated in FIG. 1 by the application program 170) which includes a mechanism for calling the phoneConfigDialog function which may be supported by any TAPI compliant application program. In this way, application programs which were not designed to support the functionality associated with the display keypad 126 may nonetheless configure the phone device 110.

FIG. 11 is a logical block diagram showing the preferred embodiment of the phone device, which was shown in block form at 110 in FIG. 1, in more detail. The phone device includes standard multifunction electronic telephone circuitry 1102 which is controlled by its own microcontroller 1104 additionally connected via control lines 1105 to an LCD keypad interface circuit 1106. Powered by a DC power source 1108, the LCD keypad interface circuit 1106 (shown in more detail in FIG. 12) is connected via the 25-line parallel interface connector 112 to the expansion card 140 in the computer 100. The LCD keypad interface circuit 1106 is also connected via LCD driver circuit 1114 (shown in more detail in FIG. 13) to receive button actuation signals from, and send display bitmaps to, the set of twelve LCD keyswitches 1116, arranged in the familiar touch-tone telephone set up of four rows-by-three columns, on the LCD keypad 126.

The multifunction, electronic telephone set circuitry 1102 is conventional and is described, for example, in *The Electronics Engineers Handbook*, 3rd ed., by Fink, Donald G. and Christiansen, Donald, eds. (1989) at pp.22-85–22-86. The telephone set 1102 operates under the control of a dedicated microcontroller as indicated at 1104. Although the preferred embodiment of the present invention utilizes an electronic telephone set as shown in FIG. 11, standard common-battery telephone set circuitry may also be used. The tip and ring telephone lines 1120 and 1122 are connected to the connected dialup telephone network by means of two data input lines in the interface connection 112 to the computer 100.

The microcomputer 1104 in the telephone set 1102 receives information from various functional circuits, such as the conventional touch-tone keypad 1124 which is preferably mounted in the handset 114 seen in FIG. 1 as noted earlier, and responds to this information by controlling other circuits, such as the speakerphone 1126. In the present invention, control instructions may be additionally be downloaded from the computer 100 under the control of the supervisory control program 162 using the TAPI data upload and download commands, permitting the microcontroller 1104 to be programmed in a variety of ways. The TAPI SPI models these phone sets as having one or more download and/or upload areas. Each area is identified by a number that ranges from zero to the number of data areas available on the phone minus one. Sizes of each area may vary and the format of the data itself is device specific to the particular phone set microcontroller. These phone set function download areas are identified by numbers distinct from the area

identifiers used to designate the key display bitmaps. The TAPI function TSPI_phoneSetData downloads a buffer of data to a given data area in the phone device RAM which may advantageously be implemented as non-volatile memory so that the phone set, once initialized to perform particular functions, need not be reprogrammed when power is interrupted. Status data and other information may be uploaded from the microcontroller **1102** using the TAPI TSPI_phoneGetData function which uploads the contents of a given data area in the phone device to a designated buffer area in the process space of the running application program using the TAPI interface. When a data area of a phone device is changed, a PHONE_STATUS message is sent to the TAPI DLL's callback to notify the TAPI DLL about the state change. Parameters to this message provide an indication of the change.

An illustrative embodiment of the LCD keypad interface circuit **1106** is shown in detail in FIG. **12** and represents an adaptation of the LCD relegendable keypad interface shown in published *PCT Application No. WO* 95/12843, assigned to Feltscope Limited. The interface circuit **1106** is connected to the 25-line interface connection **112** to the computer **100** seen in FIG. **1** via a standard 25 pin connector **1209** which connects to a standard 25-line interface cable seen at **112** in FIGS. **1** and **11**.

Information is transmitted to the phone device **110** from the computer **100** via the 8 data input lines **1206**. A buffer **1214** connects the input lines to the inputs of three data latches which receive data under the control of three strobe input lines: the address strobeline **1208**, the data strobeline **1210**, and the control strobeline **1212**. The content of the data on the input data lines **1206** differs depending on which strobeline is activated.

Data is received, eight bits at a time, from computer **100** via the eight data lines **1206** and is placed in parallel into a buffer **1214**. If the address strobeline **1208** is activated, the data on input lines **1206** placed in latch **1216** designates a particular data transfer destination for keypad **126** and identifies one of the following: 12 bitmaps destinations, 12 white lamp modes, 12 red lamp modes, and twelve green lamp modes pairs. The presence of a bitmap destination indicates that 512 data bytes (for a 64×64 pixel resolution bitmap) will be transmitted to the identified LCD key, whereas the presence of a lamp address identifies the lamp whose mode will be established by a lamp mode code supplied via data latch **1226**.

If the data strobeline **1210** is activated, the data bits received on the data lines **1206** will contain an 8-bit segment of bit map data being sent to a particular LCD keyswitch **1116** to create a specific legend on the LCD, or an 8 bit code indicating a lamp mode setting. Bitmap and lampmode data bits are sequentially latched from the buffer **1214** into a latch **1226** from which they are passed to a parallel-to-serial converter **1228**, under the control of a clock **1230**, and then to the particular LCD key or lamp register designated by the address previously received into latch **1216**.

The keypad interface circuitry may advantageously include a serial, non-volatile memory unit **1222** for holding the default bit maps to be displayed on the LCD keyswitches **1116** whenever the system has been initialized, reset, or powered down. Reset is controlled by the computer **100** via the RESET strobeline **1224** on the 25-way connector block **1110**. The default bitmaps advantageously produce a keypad display as those shown in FIG. **4** of the drawings (as used for the MANUAL modestate), except that the "Main Menu" key display is replaced by the display of asterisk "*" to reproduce completely the conventional touchtone keypad symbols. By locally storing the default keypad displays, the display keypad **126** may be used to operate the phone device in the conventional fashion, even when the computer **100** is disconnected or powered down. The non-volatile memory **1222** may be loaded from the computer **100** using the data strobe **1210** when a suitable control code is loaded int the control latch **1234**.

If the control strobeline **1212** is activated, the data bits received are passed into a latch **1234** from which they are passed to the telephone set microcontroller **1104** or equivalent phone device mechanisms to control instrumentalities including the speaker phone, the alphanumeric display panel, etc. as previously. The control strobeline **1212** is used to send commands to the standard telephone circuitry illustratively indicated at **1102** in FIG. **11**. When the control strobeline **1212** is pulsed, the datalines **1206** will contain bits representing various control commands and are are latched from the buffer **1214** to a control bit latch **1234** and thence through conventional circuitry to the microcomputer **1104** or other parts of the interface. The control commands transferred via the datalines **1206** into latch **1234** are codes written by the phone device service provider after being placed in I/O data latches (not shown) in interface circuit **140** seen in FIG. **1**, including codes for turning the speakerphone **1126** on or off and changing the volume of the speakerphone or the handset. Control commands may also include character strings sent to the display LCD **1130** under the control of the microcontroller **1104**.

FIG. **13** of the drawings illustrates an illustrative keypad interface logic circuit in more detail. Two of the twelve identical LCD display key modules are indicated in block form at **1302** and **1304**. The module **1304** includes a clock signal input **1311** for timing the transfer of serial data into a serial data input **1312** for transferring display bitmaps and backlighting lamp mode selections into the keyswitch module. As noted previously, if the LCD panel in each keyswitch displays a 64×64 pixel bitmap, 512 bytes of data are transferred serially into each keyswitch when the data enable line **1320** is enabled by a key ID decoder **1322** which receives the button/lamp address code from latch **1216** (FIG. **12**) indicating the particular button or backlighting lamp for which data is being sent over the serial data line **1312**. If the address code indicates that a lamp is being loaded, the serial data line **1312** receives a byte which specifies which lamp (white, red or green) state is to be changed as well as the new mode for that lamp. A lamp mode timing signal generator **1350** provides shared flash, flicker and wink energization signals via the shared lamp power lines **1313**, **1314** and **1315** respectively.

When an LCD keyswitch, such as the switch **1350** seen in module **1302**, has been depressed or released by a user, this information is converted into the appropriate button action code by a key ID encoder **1365** which sends an interrupt signal via line **1236** in the interface **112** to the connected computer **100** whenever a keyswitch is pressed or released. The interface microcontroller **1220** also receives the 4-bit address (button number) of the particular LCD keyswitch **1116** that was activated. A fifth bit on lines **1242** is used to indicate whether the key activation associated with the interrupt is a key press or a key release. These output bits are transferred via the interface connection **112** to the computer **100** where they are placed on the system databus concurrently with the activation of a system bus interrupt request line. The phone device driver routines **165** include an interrupt handler which formats the button identification into a the formate defined for a TAPI button message and pass that message via the TAPI SPI to the TAPI.DLL which in

turn passes the PHONE_BUTTON message via the applications callback function for handling by the control program thread. The phone device may also supply status information from the microcomputer **1104** using the same hardware/software interface to support those TAPI status reporting functions which characterize the nature and status of the connected phone device.

In the preferred embodiment the twelve LCD display keys such as those seen at **1302** and **1304** house the display in the moveable portion of the key, with the contact portion behind the movable section of the key. Such moveable, relegendable keyswitches suitable for use with the present invention are conventional and are described, for example, in European Patent No EP-A-0 232 137 assigned to Dowty Electronic Components Limited, to which reference may be made for further details. Alternatively an LCD keyswitch having a fixed display with a transparent moveable cap, such as is described in U.S. Pat. No. 4,897,651 (DeMonte) or British Patent No. GB-A-2 150 722 (Muller), may be used to implement the present invention.

The keyswitches **1302** and **1304** physically move in push-button fashion when pressed and provide tactile feedback to the user. As a result, the display keyswitchs operate in a manner fully consistent with the user's experience with the familiar "push-buttons" in conventional touch-tone telephone sets. The similar appearance and feel of the movable keys used to implement the display keyswitches as contemplated by the present invention contributes importantly to the intuitive ease with which the phone device according to the present invention can be used.

In the illustrative embodiment of the invention which has been described, each LCD keyswitch display may be selectively backlit by each of three separate colors, white, red, and green, using several lighting patterns: on full, flashing, flutter, winking or off Provision of several distinctive lamp colors for keyswitch backlighting is accomplished by associating two lamp/dummy button pairs with one lamp/active button pair and then addressing each lamp individually.

The independent control of backlighting and the bitmap displays permits the application developer to readily provide special capabilities. For example, different colors or lamp modes may be used to differentiate keys which perform functions from keys used merely to display information. Alternatively, different colors may be used to indicate status conditions; for example, keys labeled "Spkr Phone" and "Call Waiting" may be backlit in white when the speakerphone and call waiting are respectively turned off, with each key becoming backlit in green when the indicated function is turned ON. To emulate a key telephone, keys indicating different lines which are active, held, etc. may be backlit in white, white flashing, or red to indicate various states.

FIG. **14** of the drawings shows the principal data structures maintained and manipulated by the preferred embodiment of the invention. These data structures take the form of files persistently stored in the mass storage system of the computer **100** and include an account code file **1410**, a key definition file **1420**, a modestate definition file **1430**, and a phone book file **1440**.

The account code file **1410** preferably takes the form of a conventional relational database file containing information about accounts to which particular telephone calls may be charged. The account code file **1410** may typically be an existing database which is maintained by an existing records management system **1441** which may be invoked normally or from the phone device configuration dialog box **169** to add, edit or delete account identification records. When the phone device **110** is in operation, a selected key in a selected state (e.g. the "Bill To" key in the MAIN modestate as depicted in FIG. **3**) causes a message handling function at **1460** to invoke an account table lookup function **1461** which returns desired account identifiers from the account code database **1410** to a message handling function at **1460**. The account code file **1410** is preferably indexed by a displayable account identifier field so that account identifiers can be accessed and displayed in alphabetical order by name to provide a multi-level access sequence of displayed choices to the user, as illustrated by FIGS. **7** and **8**. The message handler converts the received account identifiers into suitable display bitmap form for transmission to the key displays indicated at **1463** in FIG. **14**. While a predetermined display bitmap could be stored in each account identification record file to visually designate each account, Windows GDI functions may be advantageously used to convert numeric or character string account identifiers into bitmap data structures suitable for transmission to the key displays **1463**. After the user has selected a particular accounting code from the file **1410** using the display keypad, that code is thereafter placed in a telephone connection record, along with connection start and stop times and the identification (telephone number) of the connected party, the resulting connection record being appended to the log file **1465** which may processed at any time by a report generator program **1467** to produce accounting reports as indicated at **1469**.

In a similar fashion, the phone book file **1440** may take the form of a relational database which is maintained by a conventional phone book maintenance program **1471** which may also be invoked from the phone device configuration dialog box **169** via the phone service provider DLL **165** in response to a TAPI phoneConfigDialog function invocation by an executing application program as previously discussed. When the user presses a predetermined key in a predetermined modestate (e.g. the "Phone Book" key in the MAIN modestate as seen in FIG. **3**), a message handler at **1460** invokes a phone book lookup routine **1473** which returns identification data for designated callable parties, and this identification data is then displayed on the display keys **1463** to permit the user to select the party to be dialed.

The phone book database file **1440** is also advantageously indexed by phone number such that, when caller I.D. services are available from the connected telephone service provider, the telephone number from which an incoming call originates may be checked against the database **1440** and, if a match exists, descriptive text identifying the incoming caller may be transmitted from the database **1440** to the LCD display panel seen at **124** in FIG. **1**. In a similar fashion, a short form text description of each callable party in the database **1440** is passed in bitmap form to the display keys **1463** by the lookup routine **1473** to permit the user to select a party to be dialed and, after the connection is established, a longer text description of the party with whom the connection has been established may be transmitted from the database **1440** to the LCD display **124** (as seen in the example of the call in progress modestate display seen in FIG. **10**).

In order to program the operation of the phone set **110** from the computer **100**, the configuration dialog box **169**, at the users request, invokes a modestate editor seen at **1480** which adds, deletes or edits records in the modestate definition database **1430**. Records in the file **1430** define each modestate by specifying a modestate variable for each modestate, the default alphanumeric string to be displayed on panel **124** when that modestate is active, and a set of twelve key definition identifiers each identifying a particular key definition in the file **1430**. Using the modestate editor

1430, the an installer/developer can create or modify new modestates defining new sets of keys.

The appearance and function of individual keys is determined using a key definition editor 1483 callable from the modestate editor 1480. The modestate editor advantageously displays the appearance of the twelve keys and the LCD panel in graphical form, identifies the modestate name, and permits the user to "right click" on any key display to specify the characteristics of that key.

The key definition editor allows the user to create a graphical bitmap for each key using the Windows GDI from an existing bitmap image or from specified fields in a database containing character or metafile data which can be converted into a bitmap at execution time by the Windows GDI, together with a stored code indicating the default backlighting mode for each backlight color for that key.

In addition to the bitmap and backlight mode definitions for each key, each key definition record in the database 1425 further contains a specification of the functions to be performed when that key is pressed. To this end, the key definition editor 1483 advantageously includes a script file editor for editing a macro language file which specifies the function, or sequence of functions, to be performed when each key in each modestate is actuated by the user. In operation, when a key whose display and backlight mode is defined in a predetermined the key definition record is actuated, a keypress message handler then obtains and interprets the macro script recorded for that key in its key definition record, thereby performing previously programmed operations, including switching the system to a new designated modestate and/or performing one or a sequence of functions specified by statements in the script file. The script file for a given key may be readily programmed to perform a script driven sequence of operations to dial and log onto a remote computer and thereafter to perform automated data transfer functions and the like.

When several phone devices are used in a networked environment, the account code file 1410, the phone book file 1440, the mode state definition file 1430 and the key definition file 1420 may be shared by all devices, or may that information may be stored in a combination of shared files containing shared data and locally stored files containing data which is private to a particular user.

It is to be understood that the embodiment of the invention which has been described is merely illustrative on one application of the principles of the invention. Numerous telephony functions which can be selected and controlled by means of the phone device display keypad may be added to supplement or substitute for the functions described to meet the needs of particular users and to take advantage of different capabilities available in particular installations. The features of the disclosed embodiment should accordingly be considered to be merely illustrative applications of the principles of the inventions, recognizing that numerous additions and modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

What is claimed is:

1. Telephone station equipment manipulatable by a user comprising, in combination:

a line circuit for establishing a telephone communication channel,

a telephone handset consisting of a mouthpiece microphone and an earpiece speaker,

a hook switch for connecting and disconnecting said handset and said line circuit,

a manually manipulatable keypad consisting of a plurality of movable display keys that are actuated by moving the key, each of said display keys comprising both sensing means for detecting the actuation of said key by said user and display means for visually presenting alterable display information to said user,

a programmable computer, and

a keypad interface circuit for interconnecting said computer and said keypad, said keypad interface consisting of:

input circuit means for transmitting keypress signals indicative of the actuation of each of said keys to said computer to initiate functions designated by said display information and

output circuit means for transmitting said alterable display information from said computer to said individual key displays as required for one or more of said initiated functions.

2. Telephone station equipment as set forth in claim 1 further comprising a control program executable by said computer, said program comprising:

means coupled to said output circuit means for transmitting display information to said keypad, including information for display by one or more predetermined keys representing a corresponding set of one or more key-selectable functions, and

means responsive to a keypress signal indicating the actuation of a selected one of said predetermined keys for performing the corresponding one of said key-selectable functions.

3. Telephone station equipment as set forth in claim 2 wherein said means responsive to a keypress signal indicating the actuation of a selected one of said predetermined keys comprises means for applying a dialing signal to said line circuit for establishing a telephone connection to a particular called party identified by the display information exhibited by said selected one of said keys.

4. Telephone station equipment as set forth in claim 3 wherein said means for applying a dialing signal comprises:

means for displaying the identification of a plurality of dialable parties on a corresponding first set of said keys, and

means responsive to the actuation of a given one of said first set of said keys for establishing a dialed connection to the party identified on display of said given key.

5. Telephone station equipment as set forth in claim 4 wherein said means for applying a dialing signal further comprises:

means for displaying the identification of a group of dialable parties on each of a second set of said keys, and

means responsive to the actuation of a particular key in said second set for activating said means for displaying the identification of a plurality of dialable parties.

6. Telephone station equipment as set forth in claim 3 wherein said means for applying a dialing signal comprises means for displaying a representation of a manual dialing function on a selected one of said keys, means responsive to the actuation by the user of said selected key for displaying a representation of a different dialable digit on each of a plurality of said keys, and means responsive to the actuation by the user of a key displaying a given dialable digit for generating a dialing signal representing said given dialable digit.

7. Telephone station equipment as set forth in claim 3 further including means for placing a connection established to a particular party on a hold comprising, in combination, means for displaying a representation of a hold condition on a predetermined one of said keys and means responsive to

the actuation by said user of said predetermined key for disconnecting said telephone handset from said line circuit without breaking the connection between said line circuit and said station equipment.

8. Telephone station equipment as set forth in claim 3 further including speakerphone apparatus comprising a pickup microphone and loudspeaker separate from said handset, means for displaying a representation of said speakerphone on a preselected key, and means responsive to the actuation by said user of said preselected key for activating said speakerphone apparatus.

9. Telephone station equipment as set forth in claim 3 further comprising means for persistently storing a telephone connection record for each telephone connection established, said record including an identification of the connected party and the time at which said connection was established.

10. Telephone station equipment as set forth in claim 9 wherein said record further includes information defining the duration of said connection.

11. Telephone station equipment as set forth in claim 9 further including means for displaying on each of a collection of said keys a category representation and means responsive to actuation of one of said collection of keys for recording a category identifier corresponding to said category representation in said record.

12. Telephone station equipment as set forth in claim 3 further including a display device independent of said display keypad for displaying alphanumeric information, and means for selectively displaying status information to said user on said display device, said status information including the an identification of party with whom the current connection is established.

13. Telephone station equipment manipulatable by a user for establishing a telephone communication connection over a telephone line circuit to a remote party, said equipment comprising, in combination:

a telephone station set comprising:

a microphone for accepting audio information from said user,

a speaker for delivering audio information to said user, and

a manually manipulatable keypad consisting of a plurality of display keys, each of said display keys comprising a movable push-button manipulatable by said user, sensing means for detecting the depression and release of said push-button by said user, and writable display means positioned on the exposed face of said push-button for visually exhibiting alterable display information to said user,

a programmable computer, and

a keypad interface circuit for interconnecting said computer and said keypad, said keypad interface consisting of:

input circuit means for transmitting keypress signals indicative of the actuation of each of said keys to said computer to initiate functions designated by said display information and

output circuit means for transmitting said alterable display information from said computer to said individual key displays as required for one or more of said initiated functions.

14. Telephone station equipment as set forth in claim 13 wherein each of said display keys further comprises means for exhibiting said display information in different colors and wherein said keypad interface further includes means for transmitting display control information to each of said display keys from said computer to specify the color of said display information.

15. Telephone station equipment as set forth in claim 13 wherein each of said display keys includes graphical display screen mounted on the face said key for displaying images defined by image data transmitted from said computer.

16. Telephone station equipment as set forth in claim 15 further including a controllable light source associated with each of said display keys for illuminating said display screen in accordance with an illumination value supplied to each of said display keys from said computer.

17. Telephone station equipment as set forth in claim 16 further comprising a control program executable by said computer, said program comprising:

means coupled to said output circuit means for transmitting display information to said keypad, including information for display by one or more predetermined keys representing a corresponding set of one or more key-selectable functions, and

means responsive to a keypress signal indicating the actuation of a selected one of said predetermined keys for performing the corresponding one of said key-selectable functions.

18. Telephone station equipment as set forth in claim 16 wherein said means responsive to a keypress signal indicating the actuation of a selected one of said predetermined keys comprises means for applying a dialing signal to said line circuit for establishing a telephone connection to a particular called party identified by the display information exhibited by said selected one of said keys.

19. Telephone station equipment as set forth in claim 18 wherein said means for applying a dialing signal comprises:

means for displaying the identification of a plurality of dialable parties on a corresponding first set of said keys, and

means responsive to the actuation of a given one of said first set of said keys for establishing a dialed connection to the party identified on display of said given key.

20. Telephone station equipment as set forth in claim 18 wherein said means for applying a dialing signal further comprises:

means for displaying the identification of a group of dialable parties on each of a second set of said keys, and

means responsive to the actuation of a particular key in said second set for activating said means for displaying the identification of a plurality of dialable parties.

21. Telephone station equipment as set forth in claim 16 wherein said means for applying a dialing signal comprises means for displaying a representation of a manual dialing function on a selected one of said keys, means responsive to the actuation by the user of said selected key for displaying a representation of a different dialable digit on each of a plurality of said keys, and means responsive to the actuation by the user of a key displaying a given dialable digit for generating a dialing signal representing said given dialable digit.

22. Telephone station equipment as set forth in claim 16 further including means for placing a connection established to a particular party on a hold comprising, in combination, means for displaying a representation of a hold condition on a predetermined one of said keys and means responsive to the actuation by said user of said predetermined key for disconnecting said telephone handset from said line circuit without breaking the connection between said line circuit and said station equipment.

23. Telephone station equipment as set forth in claim 16 further including speakerphone apparatus comprising a

pickup microphone and loudspeaker separate from said handset, means for displaying a representation of said speakerphone on a preselected key, and means responsive to the actuation by said user of said preselected key for activating said speakerphone apparatus.

24. Telephone station equipment as set forth in claim 16 further comprising means for persistently storing a telephone connection record for each telephone connection established, said record including an identification of the connected party and the time at which said connection was established.

25. Telephone station equipment as set forth in claim 24 wherein said record further includes information defining the duration of said connection.

26. Telephone station equipment as set forth in claim 25 further including means for displaying on each of a collection of said keys a category representation and means responsive to actuation of one of said collection of keys for recording a category identifier corresponding to said category representation in said record.

27. A telephone system control mechanism comprising, in combination:

a telephone communications circuit for establishing connections with remote parties,

a display keypad consisting of a plurality of movable push-button keys each given key including a display panel positioned on the exposed face of said given key for displaying an visual image to a user, said image being defined by display data, and

a sensor for generating keypress signals whenever said given key is actuated by said user,

a personal computer including a memory and a processor for executing programs stored in said memory, said programs including a control program, said personal computer comprising:

means for placing said computer in a first of a plurality of mode states, means responsive to the activation of a selected one of said keys when said computer is in said first mode state for performing an operation signified by the image displayed on the face of said selected key,

means for switching said computer to a different mode state specified by said selected key to thereafter process the activation of said keys in said different mode state, and

means coupled to said display keypad for transmitting said display data to said keys to represent at least one function executable by said processor in said different mode state.

* * * * *

US006456699B1

(12) **United States Patent**
Burg et al.

(10) **Patent No.: US 6,456,699 B1**
(45) **Date of Patent: Sep. 24, 2002**

(54) **WEB-BASED GENERATION OF TELEPHONY-BASED INTERACTIVE VOICE RESPONSE APPLICATIONS**

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(73) Assignee: **AT&T Corp.**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/201,180**

(22) Filed: **Nov. 30, 1998**

(51) **Int. Cl.**[7] **H04M 1/64**; H04M 3/42; H04M 3/00

(52) **U.S. Cl.** **379/88.17**; 379/67.1; 379/88.13; 379/201.03; 379/265.09; 379/266.07; 379/908

(58) **Field of Search** 379/67.1, 76, 88.01, 379/88.04, 88.13, 88.14, 88.15–88.17, 88.18, 88.22, 88.23, 88.24, 88.25, 93.09, 93.11, 93.12–93.17, 100.01, 100.13, 102.03, 201, 213, 216, 900, 902, 908, 265.09, 265.02, 266.07, 201.01, 201.03, 201.12; 704/270, 271, 260, 290, 275; 707/218, 501; 709/513, 531

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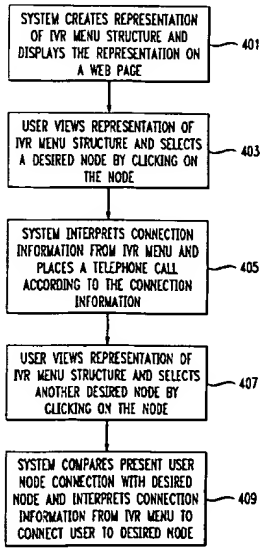
Primary Examiner—Allan Hoosain

(57) **ABSTRACT**

A computer system and method for analysis and translation of Web on-line menu architectures to Interactive Voice Response (IVR) menu architectures. The system analyzes Uniform Resource Location (URL) links in HyperText Markup Language (HTML) documents that comprise the Web menus and develops corresponding IVR menus. Once the system has developed a validated IVR menu architecture, the system supports both on-line Web users and IVR users with a common set of structured information databases. The system and method also supports analysis and translation of IVR menu architectures to support Web on-line users. The common information databases contain the IVR and Web menu architectures as well as product specifications and prices.

10 Claims, 9 Drawing Sheets



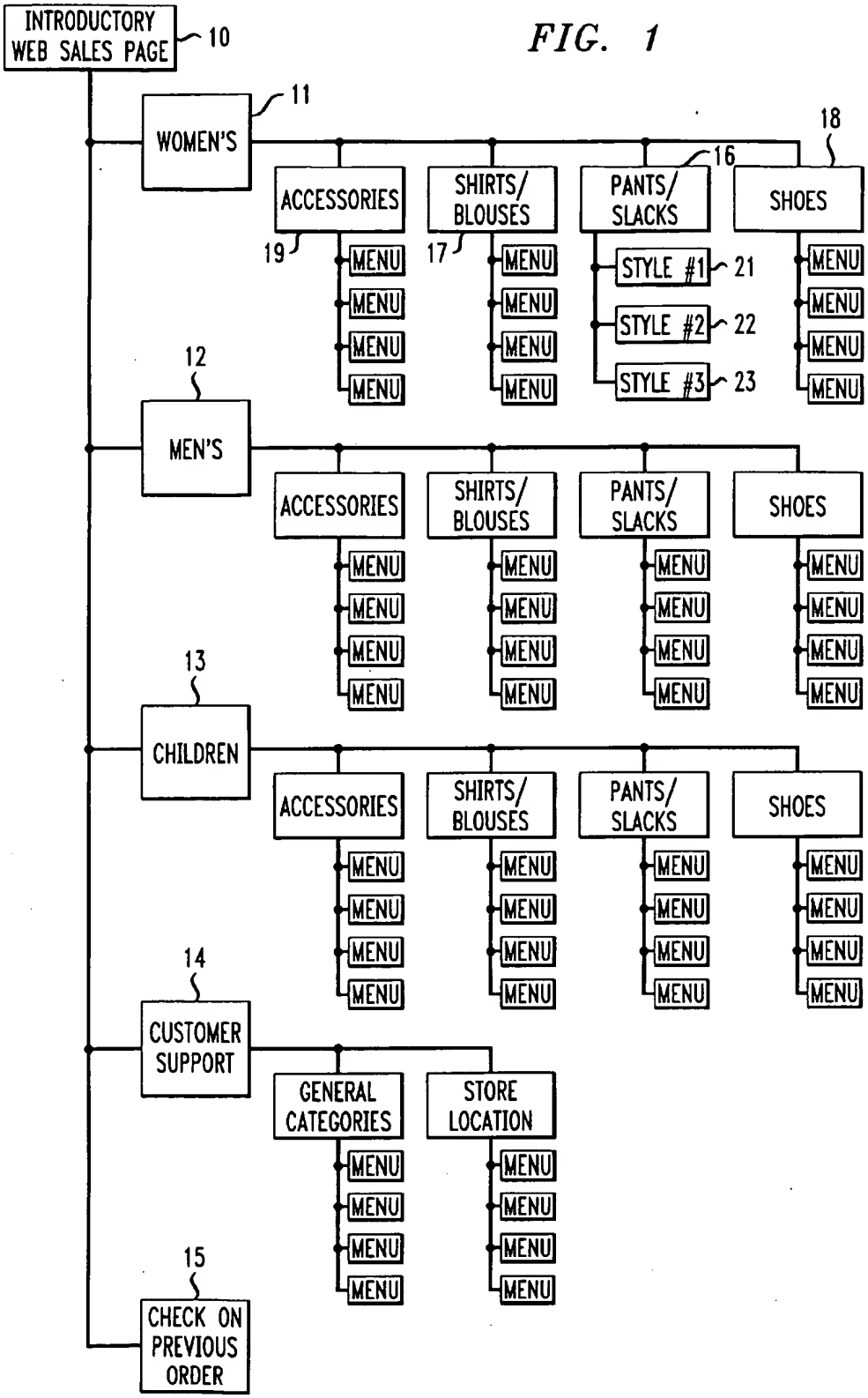

INTRODUCTORY WEB SALES PAGE
10
WOMEN'S
11
ACCESSORIES
SHIRTS/ BLOUSES
PANTS/ SLACKS
SHOES
16
18
19
17
MENU
STYLE #1
21
STYLE #2
22
STYLE #3
23
MEN'S
12
CHILDREN
13
CUSTOMER SUPPORT
14
GENERAL CATEGORIES
STORE LOCATION
CHECK ON PREVIOUS ORDER
15

FIG. 1

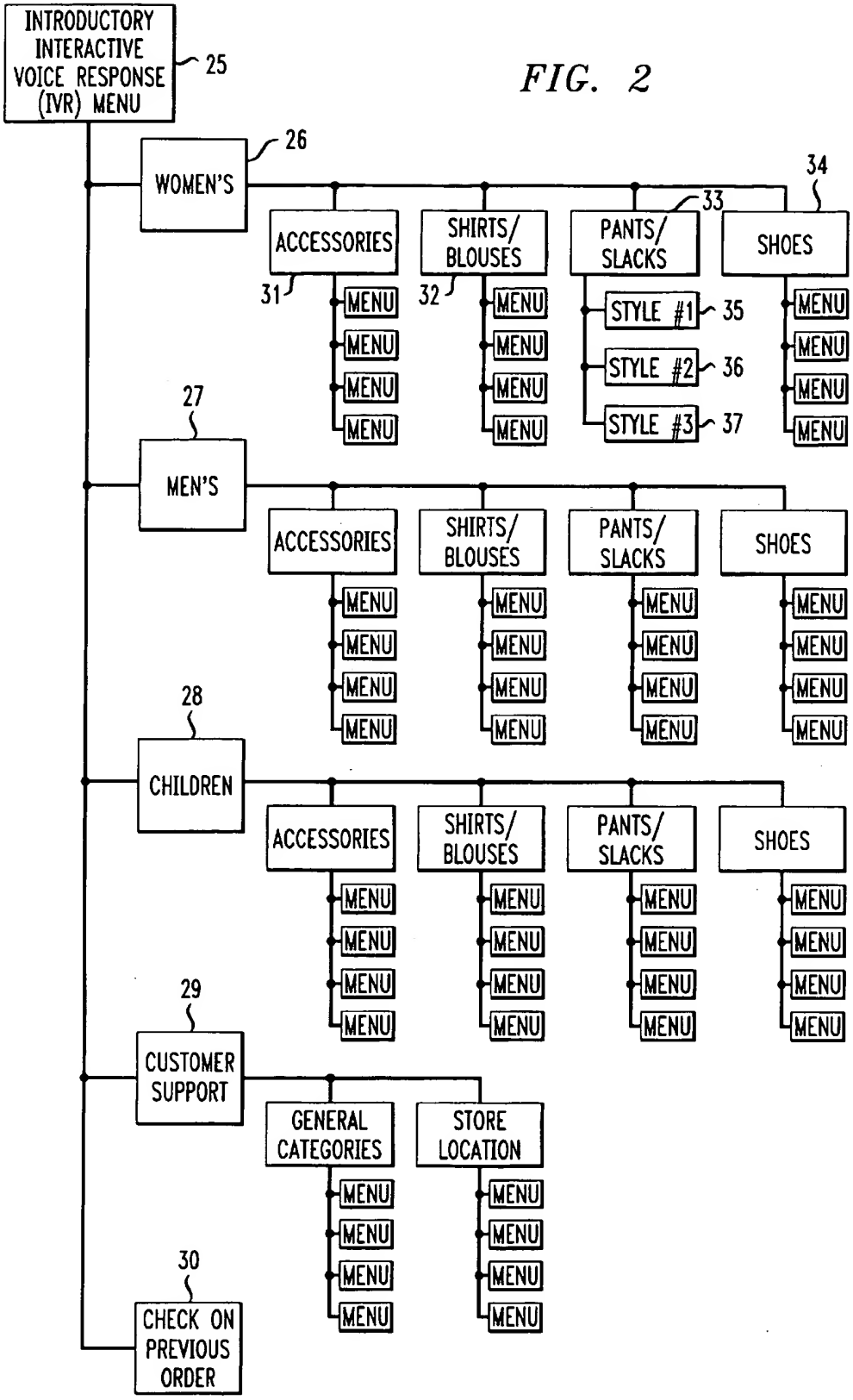

INTRODUCTORY INTERACTIVE VOICE RESPONSE (IVR) MENU
25
WOMEN'S
26
ACCESSORIES
31
SHIRTS/ BLOUSES
32
PANTS/ SLACKS
33
SHOES
34
STYLE #1
35
STYLE #2
36
STYLE #3
37
MEN'S
27
CHILDREN
28
CUSTOMER SUPPORT
29
GENERAL CATEGORIES
STORE LOCATION
CHECK ON PREVIOUS ORDER
30
MENU

FIG. 2

FIG. 3

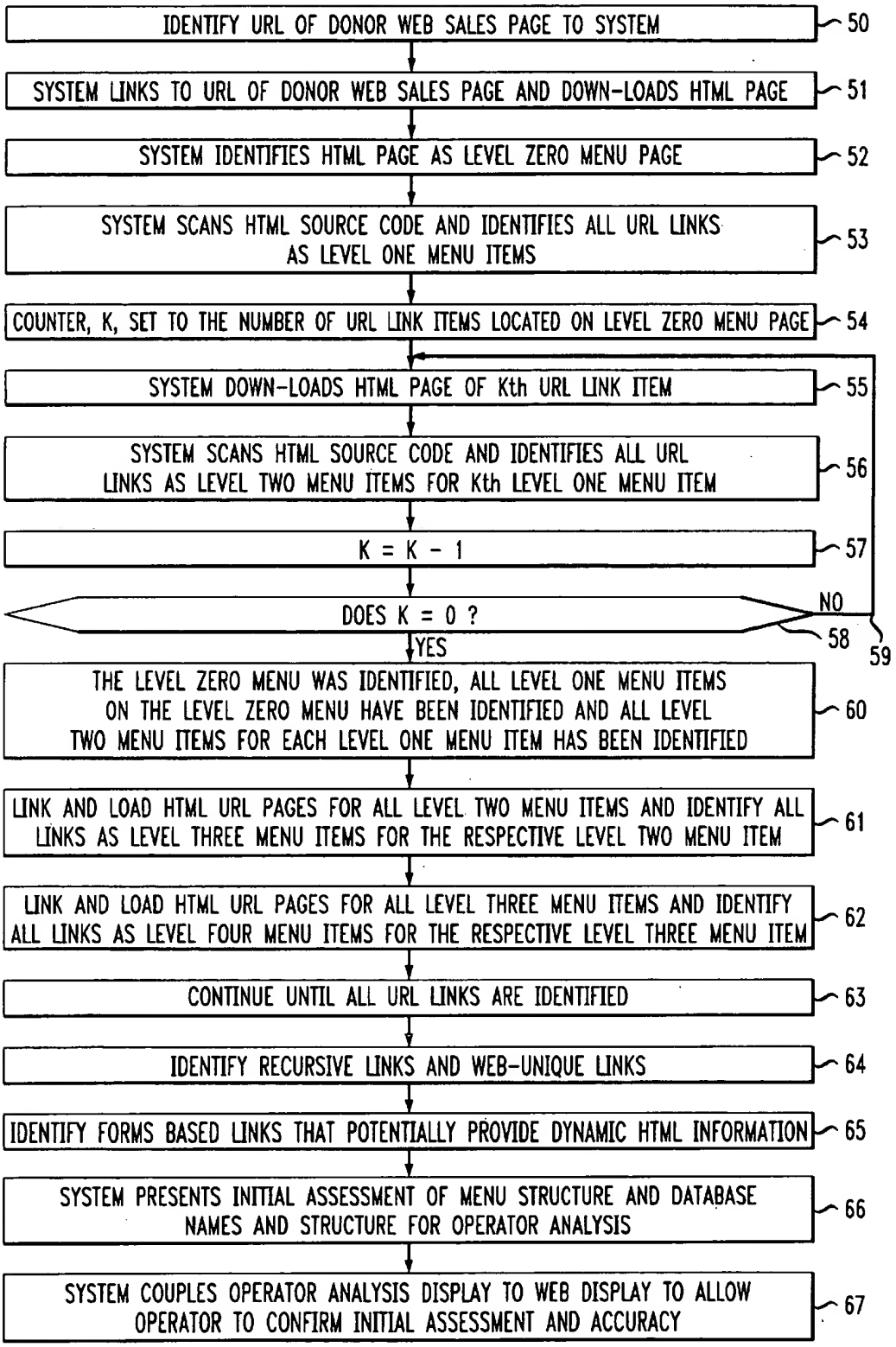

IDENTIFY URL OF DONOR WEB SALES PAGE TO SYSTEM
50
SYSTEM LINKS TO URL OF DONOR WEB SALES PAGE AND DOWN-LOADS HTML PAGE
51
SYSTEM IDENTIFIES HTML PAGE AS LEVEL ZERO MENU PAGE
52
SYSTEM SCANS HTML SOURCE CODE AND IDENTIFIES ALL URL LINKS AS LEVEL ONE MENU ITEMS
53
COUNTER, K, SET TO THE NUMBER OF URL LINK ITEMS LOCATED ON LEVEL ZERO MENU PAGE
54
SYSTEM DOWN-LOADS HTML PAGE OF Kth URL LINK ITEM
55
SYSTEM SCANS HTML SOURCE CODE AND IDENTIFIES ALL URL LINKS AS LEVEL TWO MENU ITEMS FOR Kth LEVEL ONE MENU ITEM
56
K = K - 1
57
DOES K = 0 ?
NO
58
59
YES
THE LEVEL ZERO MENU WAS IDENTIFIED, ALL LEVEL ONE MENU ITEMS ON THE LEVEL ZERO MENU HAVE BEEN IDENTIFIED AND ALL LEVEL TWO MENU ITEMS FOR EACH LEVEL ONE MENU ITEM HAS BEEN IDENTIFIED
60
LINK AND LOAD HTML URL PAGES FOR ALL LEVEL TWO MENU ITEMS AND IDENTIFY ALL LINKS AS LEVEL THREE MENU ITEMS FOR THE RESPECTIVE LEVEL TWO MENU ITEM
61
LINK AND LOAD HTML URL PAGES FOR ALL LEVEL THREE MENU ITEMS AND IDENTIFY ALL LINKS AS LEVEL FOUR MENU ITEMS FOR THE RESPECTIVE LEVEL THREE MENU ITEM
62
CONTINUE UNTIL ALL URL LINKS ARE IDENTIFIED
63
IDENTIFY RECURSIVE LINKS AND WEB-UNIQUE LINKS
64
IDENTIFY FORMS BASED LINKS THAT POTENTIALLY PROVIDE DYNAMIC HTML INFORMATION
65
SYSTEM PRESENTS INITIAL ASSESSMENT OF MENU STRUCTURE AND DATABASE NAMES AND STRUCTURE FOR OPERATOR ANALYSIS
66
SYSTEM COUPLES OPERATOR ANALYSIS DISPLAY TO WEB DISPLAY TO ALLOW OPERATOR TO CONFIRM INITIAL ASSESSMENT AND ACCURACY
67

FIG. 4

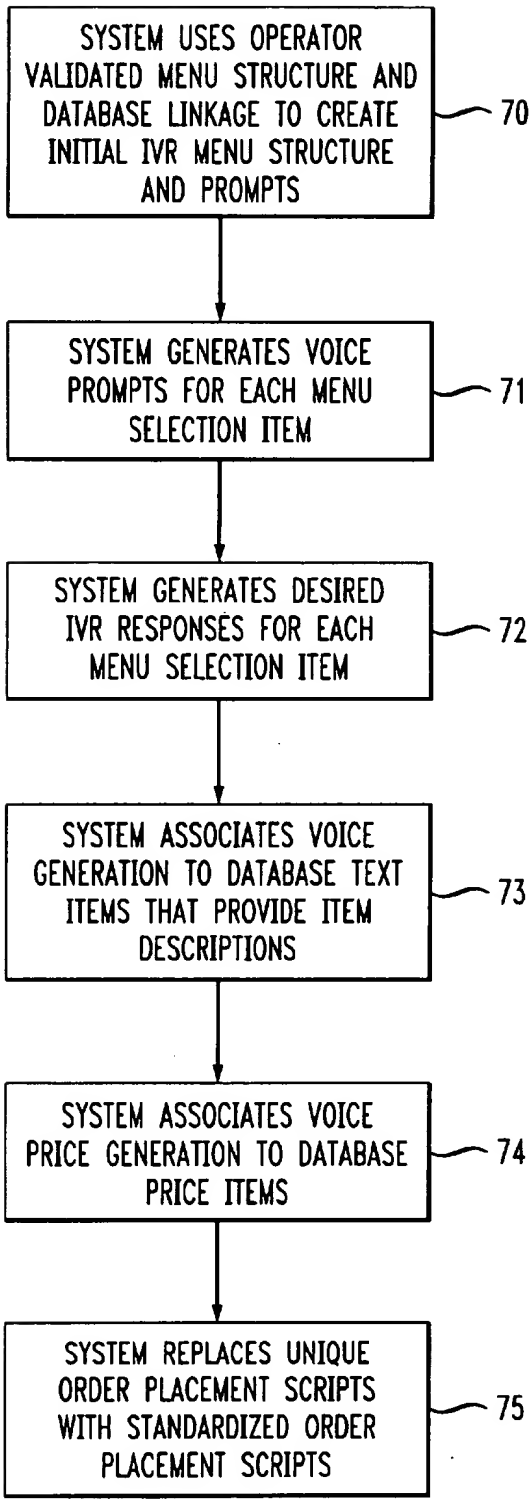

SYSTEM USES OPERATOR VALIDATED MENU STRUCTURE AND DATABASE LINKAGE TO CREATE INITIAL IVR MENU STRUCTURE AND PROMPTS
70
SYSTEM GENERATES VOICE PROMPTS FOR EACH MENU SELECTION ITEM
71
SYSTEM GENERATES DESIRED IVR RESPONSES FOR EACH MENU SELECTION ITEM
72
SYSTEM ASSOCIATES VOICE GENERATION TO DATABASE TEXT ITEMS THAT PROVIDE ITEM DESCRIPTIONS
73
SYSTEM ASSOCIATES VOICE PRICE GENERATION TO DATABASE PRICE ITEMS
74
SYSTEM REPLACES UNIQUE ORDER PLACEMENT SCRIPTS WITH STANDARDIZED ORDER PLACEMENT SCRIPTS
75

FIG. 5

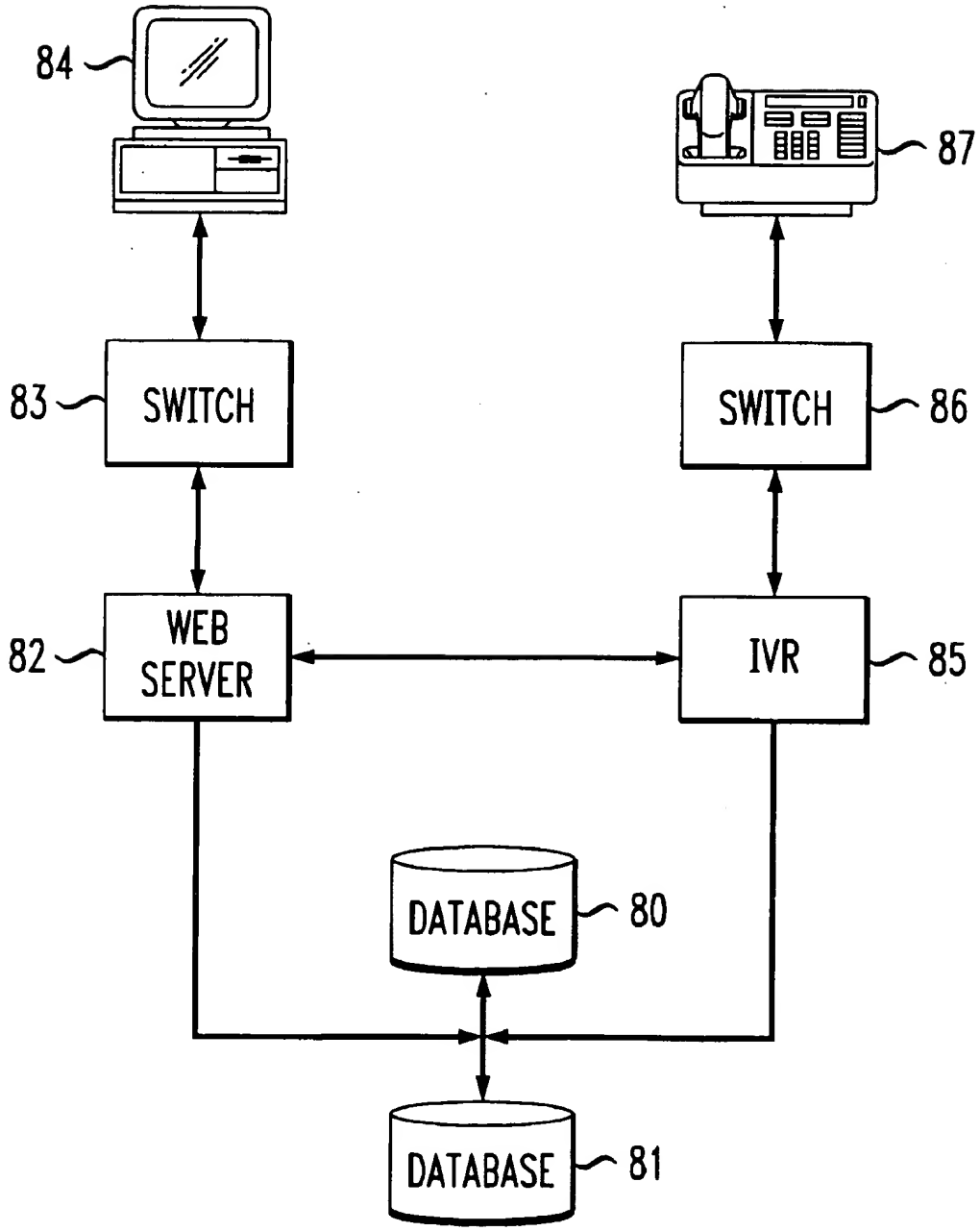

79
84
87
83
SWITCH
SWITCH
86
82
WEB SERVER
IVR
85
DATABASE
80
DATABASE
81

FIG. 6

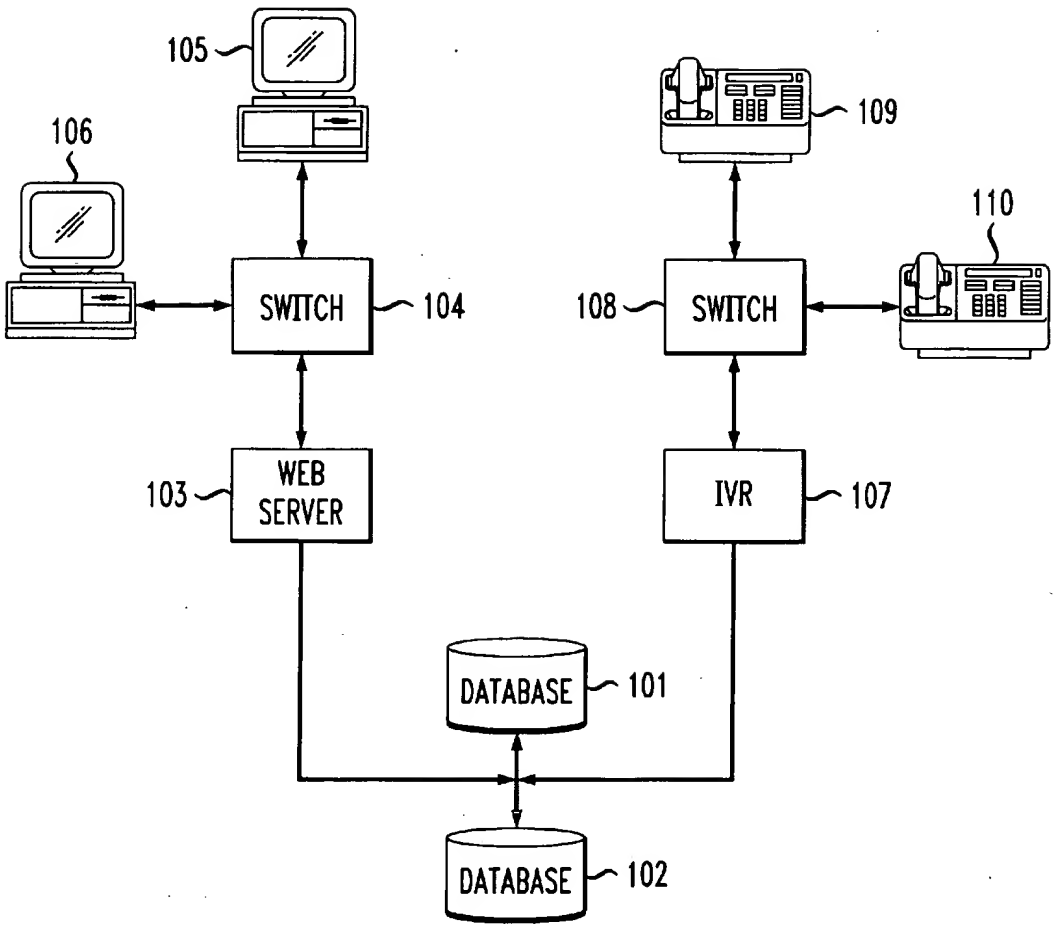
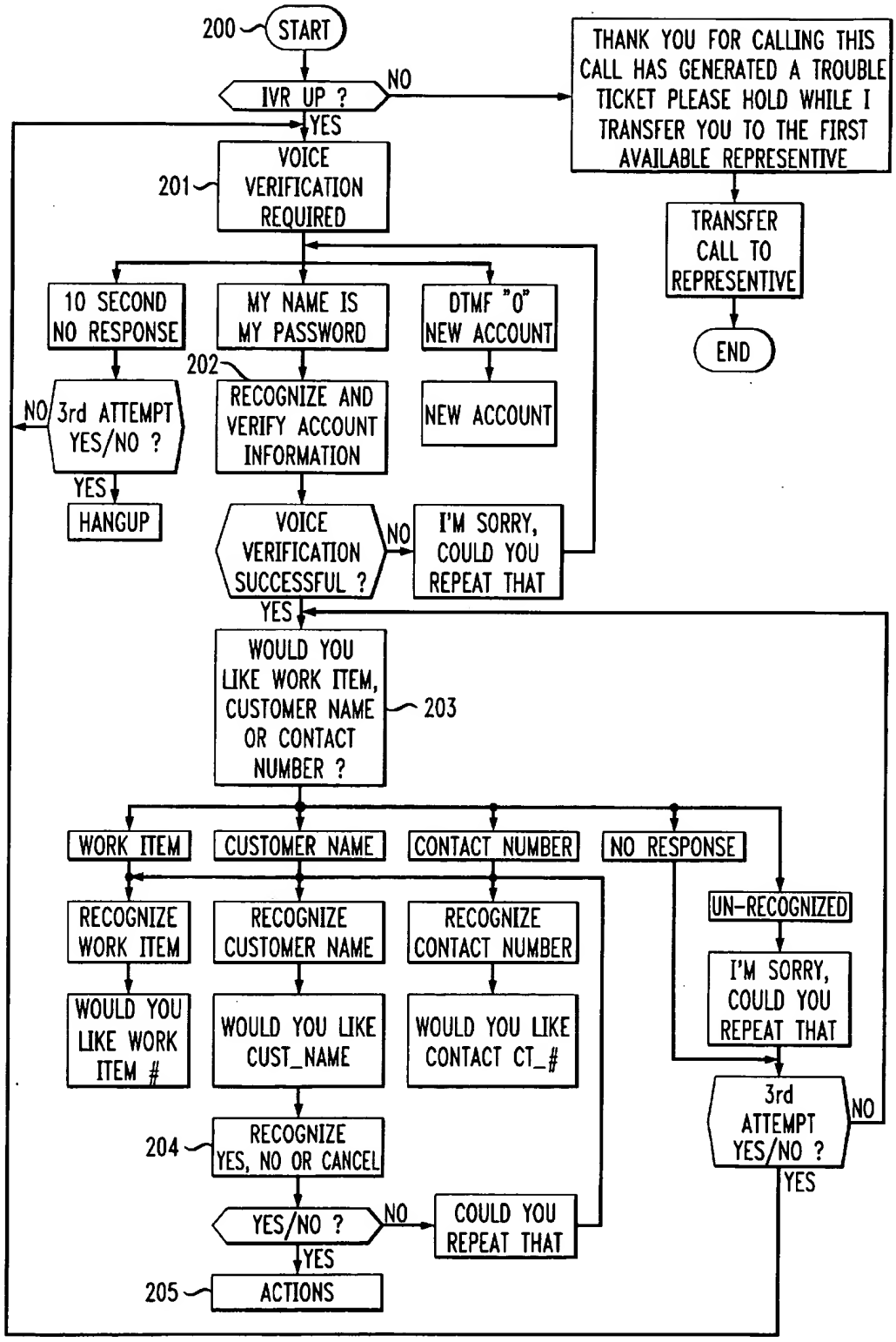

99
105
106
109
110
SWITCH
104
108
SWITCH
WEB SERVER
103
IVR
107
DATABASE
101
DATABASE
102

FIG. 7


200
START
IVR UP ?
NO
YES
THANK YOU FOR CALLING THIS CALL HAS GENERATED A TROUBLE TICKET PLEASE HOLD WHILE I TRANSFER YOU TO THE FIRST AVAILABLE REPRESENTIVE
TRANSFER CALL TO REPRESENTIVE
END
201
VOICE VERIFICATION REQUIRED
10 SECOND NO RESPONSE
MY NAME IS MY PASSWORD
DTMF "0" NEW ACCOUNT
202
NO
3rd ATTEMPT YES/NO ?
RECOGNIZE AND VERIFY ACCOUNT INFORMATION
NEW ACCOUNT
YES
HANGUP
VOICE VERIFICATION SUCCESSFUL ?
NO
I'M SORRY, COULD YOU REPEAT THAT
YES
WOULD YOU LIKE WORK ITEM, CUSTOMER NAME OR CONTACT NUMBER ?
203
WORK ITEM
CUSTOMER NAME
CONTACT NUMBER
NO RESPONSE
RECOGNIZE WORK ITEM
RECOGNIZE CUSTOMER NAME
RECOGNIZE CONTACT NUMBER
UN-RECOGNIZED
WOULD YOU LIKE WORK ITEM #
WOULD YOU LIKE CUST_NAME
WOULD YOU LIKE CONTACT CT_#
I'M SORRY, COULD YOU REPEAT THAT
3rd ATTEMPT YES/NO ?
NO
YES
204
RECOGNIZE YES, NO OR CANCEL
YES/NO ?
NO
COULD YOU REPEAT THAT
YES
205
ACTIONS

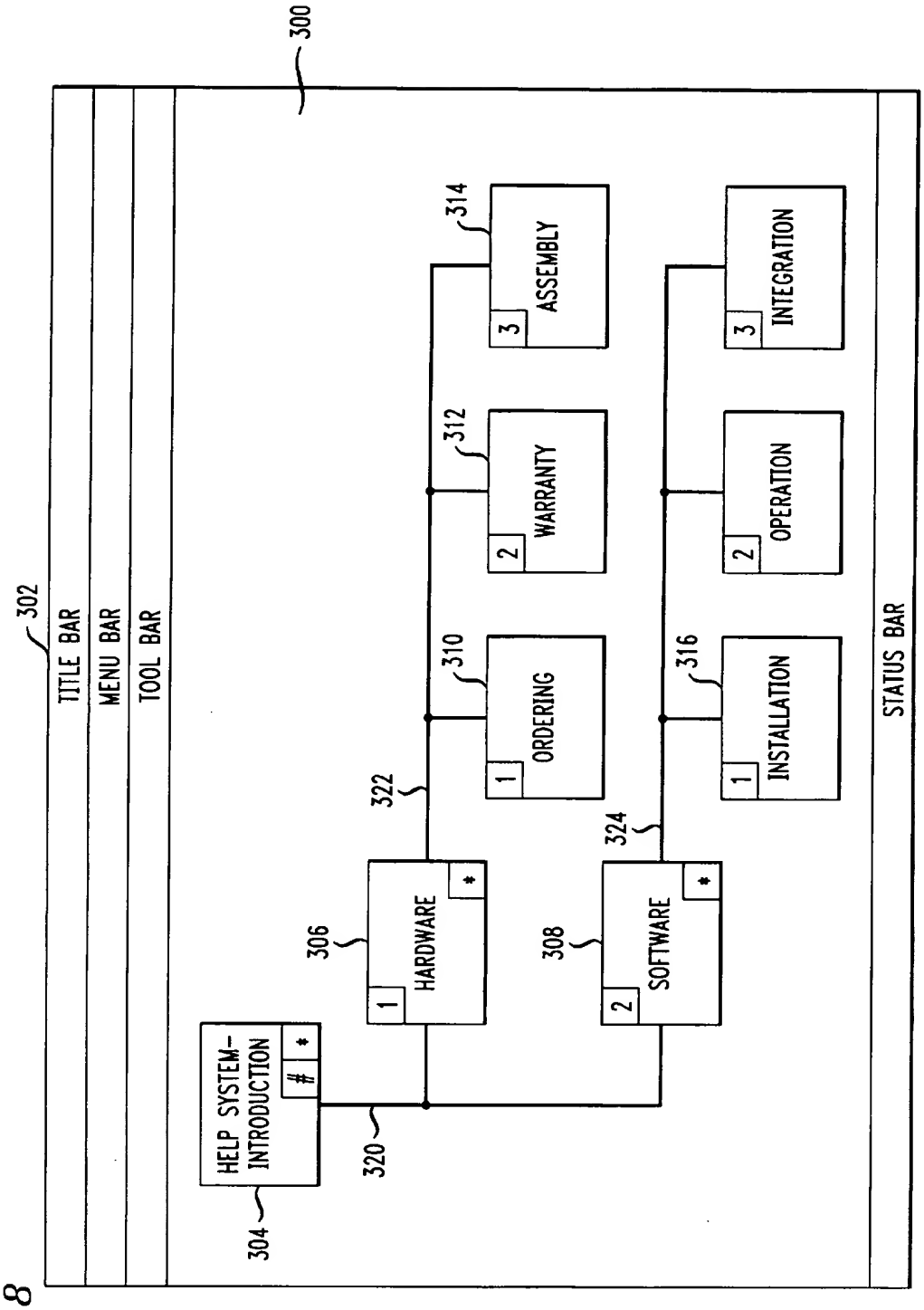
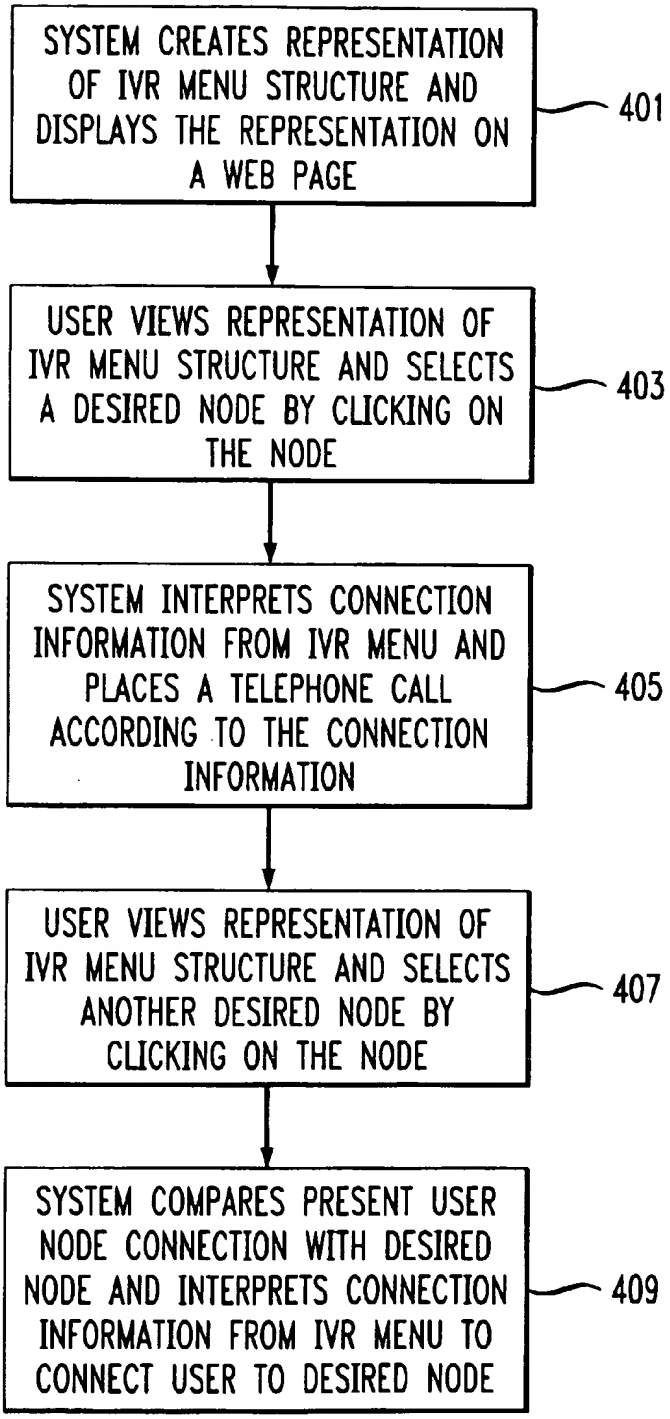

300
302
TITLE BAR
MENU BAR
TOOL BAR
STATUS BAR
HELP SYSTEM-INTRODUCTION
#
*
304
320
HARDWARE
1
*
306
322
SOFTWARE
2
*
308
324
ORDERING
1
310
WARRANTY
2
312
ASSEMBLY
3
314
INSTALLATION
1
316
OPERATION
2
INTEGRATION
3

FIG. 8

FIG. 9


SYSTEM CREATES REPRESENTATION OF IVR MENU STRUCTURE AND DISPLAYS THE REPRESENTATION ON A WEB PAGE
401
USER VIEWS REPRESENTATION OF IVR MENU STRUCTURE AND SELECTS A DESIRED NODE BY CLICKING ON THE NODE
403
SYSTEM INTERPRETS CONNECTION INFORMATION FROM IVR MENU AND PLACES A TELEPHONE CALL ACCORDING TO THE CONNECTION INFORMATION
405
USER VIEWS REPRESENTATION OF IVR MENU STRUCTURE AND SELECTS ANOTHER DESIRED NODE BY CLICKING ON THE NODE
407
SYSTEM COMPARES PRESENT USER NODE CONNECTION WITH DESIRED NODE AND INTERPRETS CONNECTION INFORMATION FROM IVR MENU TO CONNECT USER TO DESIRED NODE
409

WEB-BASED GENERATION OF TELEPHONY-BASED INTERACTIVE VOICE RESPONSE APPLICATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to the field of database manipulation and more particularly to the field of structured databases such as used by on-line Web-based application, structured databases by interactive voice response applications and shared or common use of those structured database.

2. Description of the Related Art

The World Wide Web (WWW) or "the Web" provides a computer user with electronic access to documents located on data servers throughout the world. The standard document format for the Web is HyperText Markup Language (HTML). HTML documents can be static or dynamic. Static HTML documents contain all information required to generate the Web page.

Dynamic HTML documents contain a shell for the Web page, but dynamically insert information into the shell at the time a user links to the HTML document or modifies information in a document. These characteristics of dynamic HTML are described by Isaacs S., *Inside Dynamic HTML*, Microsoft Press, 1997, which is incorporated herein by reference. Dynamic Web pages are also described in U.S. Pat. No. 5,761,673 issued to Bookman et al which is incorporated herein by reference. Use of relational databases over the Internet, which can be an integral part of dynamic HTML is described in U.S. Pat. No. 5,737,592 issued to Nguyen et al which is incorporated herein by reference.

The concept of providing interactive voice response (IVR) to telephone calls is also known. IVR provides automated response to a customer by providing prompts and detecting customer responses to the prompts through either keypad entries or spoken words. IVR is described in a number of patents, including U.S. Pat. No. 5,588,044 to Lofgren et al.; U.S. Pat. No. 5,678,002 to Fawcett et al; and 5,493,608 to O'Sullivan, the disclosures of which are incorporated herein by reference.

Both Web and IVR systems use menu structures and structured databases to organize the customer interaction and control access to information. When Web and IVR systems have similar objectives, there can be substantial similarity in the menu structures and structured database of each system.

There is a need to relate the menu structures and structured database information supporting on-line Web users and IVR users.

BRIEF SUMMARY OF THE INVENTION

An objective is to provide a computer method comprising the steps of identifying a structured database that supports on-line users as suitable for interactive voice response; analyzing the structured database; and generating an interactive voice response menu based on the database analysis. The menu is usable for interactive voice response. The structured database includes HTML documents and scripts which support the on-line users.

Another objective is to provide a computer method comprising the steps of identifying a structured database that includes hypertext mark-up language documents and supports on-line users as suitable for interactive voice response; analyzing the structured database; generating an interactive voice response menu based on the database analysis; and using the menu to support caller interaction with the database during a communication conducted with interactive voice response.

Another objective is to provide a computer method comprising the steps of communicating using interactive voice response; and responsive to the recognized voice, providing interactive choices derived from a structured database, the structured database supporting at least the interactive choices and on-line users. The structured database includes HTML documents and scripts and the structured database supports the on-line users through a Web browser.

Another objective is to provide a computer method comprising the steps of communicating using interactive voice response; and responsive to the recognized voice, providing interactive choices derived from a structured database, the structured database providing information for the interactive choices and on-line accessible hypertext mark-up language documents.

Another objective is to provide a computer method comprising the steps of analyzing a structured database that supports interactive voice response users; and generating links to the structured database based on the database analysis, the links being usable for on-line users.

Another objective is to provide a system comprising at least one structured database; an on-line server, electronically linked to the at least one structured database and allowing the system to support on-line users by using information in the at least one structured database; and an interactive voice response server, electronically linked to the at least one structured database and allowing the system to support customers connected to the interactive voice response server by using information in the at least one structured database.

Another objective is to provide a system comprising at least one structured database; an on-line server, electronically linked to the at least one structured database and allowing the system to support on-line users by using information in the structured database; and an interactive voice response server, electronically linked to the on-line server, the system analyzing a menu structure supporting the on-line users and creating an interactive voice response menu structure to support a user connected to the interactive voice response server.

Another objective is to provide a system comprising at least one structured database; and a server, the server electronically linked to the at least one structured database and allowing the system to support on-line users by using information in the at least one structured database and the server electronically linked to the at least one structured database and allowing the system to support customers connected to the server by using information in the at least one structured database.

Another objective is to provide a system and method to analyze a menu structure that supports interactive voice response users and generate a graphic representation of the menu structure using the analysis. The graphic representation of the menu structure is usable for on-line users and allows the system to make a telephone connection of an on-line user to a choice on the graphic representation of the menu structure. The system makes the telephone connection by either replicating the choices of the interactive voice response menu, or bypassing the choices and direct dialing to the desired choice. The system dials with a TAPI interface, or a form of Internet telephony.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an on-line Web sales menu architecture;

FIG. **2** illustrates an Interactive Voice Response (IVR) sales menu architecture;

FIG. **3** illustrates steps for translating a Web on-line sales menu to an IVR menu architecture;

FIG. **4** illustrates steps for translating a Web on-line sales menu to an IVR menu architecture;

FIG. **5** illustrates a development system of the invention;

FIG. **6** illustrates an operational system of the invention;

FIG. **7** illustrates an IVR system;

FIG. **8** illustrates a Web page depiction of an IVR menu architecture; and

FIG. **9** illustrates steps for connecting to different nodes of an IVR menu that is displayed on a Web page.

DETAILED DESCRIPTION OF THE INVENTION

Interactive voice response (IVR) provides automated access to customers and business representatives by responding to keypad entries or spoken words. FIG. **7** illustrates the initial access steps of a typical IVR system supporting business representatives.

At step **200**, the business representative establishes initial contact with the IVR system.

At step **201**, if the IVR system is operating, the system requires voice verification or entry of "0" for a new account.

At step **202**, after the representative provides a password, the IVR system verifies the voice password.

At step **203**, if the password was correctly verified, the IVR system prompts the representative for a work item, a customer name or a contract number.

At step **204**, the IVR system verifies that it has correctly interpreted the desired item.

At step **205**, the IVR system provides the representative the opportunity to take action on the selected item.

The IVR system additionally provides looping functions when the representative's response is not understood, or where a response is not received within a specified time period. The IVR system illustrated in FIG. **7** is designed to support the initial access by a business representative. Other IVR systems support telephone sales and voice-mail systems.

For many companies, a substantial business sector relies on customer-merchant relationships that are not face-to-face. Some of these relationships take the form of catalog sales and on-line sales. Catalog sales rely heavily on telephone ordering, and companies with a substantial catalog sales volume develop sales and information architectures that specifically support telephone ordering.

Companies with substantial catalog sales volume must also balance the need for live telephone sales staff against their expense. Interactive automated techniques are usually less expensive and where automated customer sales and support can provide satisfactory response to the customer, the companies will use interactive automated techniques. These interactive automated techniques include computer generated voice response menus designed for interactive customer response. Just as for other IVR systems, catalog sales interactive techniques use touch-tone telephones and voice responses.

Though businesses that rely on telephone ordering may not be able to completely eliminate live sales support staff in all telephone order transactions, the businesses are able to significantly reduce their sales staff size by using IVR for routine and well structured telephone ordering tasks. However, an IVR system that is able to replace live sales support staff, even during routine order processing, is difficult to establish. The system must have excellent voice response and speech generation to understand different dialects and accents and provide responsive answers. Additionally, the IVR system must have robust supporting databases containing product specifications and pricing information. These product specification and pricing databases are frequently unique to IVR systems and not well adapted to other business purposes.

A business with an established telephone catalog order sector, using IVR, spends considerable expense developing and maintaining databases. Given the substantial startup cost to establish IVR, only large businesses use IVR and are able to reap the reduced cost benefits.

Today, many businesses are establishing an on-line electronic sales presence with Web pages that list product specifications and prices. The Web pages typically include images representing product with textual descriptions. On-line ordering is also available and companies develop and place forms on their Web pages to automatically process on-line customer orders.

With extensive product lines, companies typically shift from static HTML content on their Web page to dynamic HTML content. With static HTML, all the Web page information is known and coded when the Web page is developed. This is a reasonably inexpensive though time-consuming process. Once developed, a static HTML Web page does not allow rapid change or update. Further, a static HTML Web page does not readily support short duration events like sales, because each Web page must be changed and checked before the sale event and after the sales event.

With dynamic HTML, the basic Web page format is developed, but the actual HTML page content is extracted from databases at the time the customer accesses the uniform resource locator (URL) of the Web page. In this manner, the business makes changes to their databases, which are used to generate the HTML documents of the Web page. Changes to databases are much easier to accomplish and can be completed in near-real-time. Thus, short duration events, like sales, become possible with an on-line Web business using dynamic HTML.

The information needed to support on-line electronic sales and telephone catalog ordering is very similar and in may cases is identical. The customer needs ready access to accurate and up-to-date product specification, availability and price. Many businesses are willing to invest the expense required to establish and maintain structured databases for an on-line electronic sales presence on the Web, but do not have IVR for their telephone based catalog ordering. Additionally, many customers are not confident in the security of on-line electronic sales ordering and will search for product on-line, but place their order using the telephone. Thus, the ability to adapt and use structured databases that are developed for on-line sales to support IVR is very beneficial. The business is able to take advantage of the previously developed and maintained on-line databases and Web menu structure by using the same menu structure and databases as the foundation for IVR telephone sales. As a result, the business reduces their expense for live telephone sales support staff and eliminates inconsistencies when a customer searches for a product on-line and places the order by phone.

Most on-line Web based sales and most IVR systems use a hierarchical menu structure. This structure allows the customer to rapidly locate desired products and services. Once the customer has generally located the desired product or service, the menu structure allows the customer to learn about the product. For clothing, the system typically provides sizing and color information with availability of the desired combination. Product prices are also provided. On-line systems typically provide a representative image of the product. Once the customer decides to purchase a particular product, systems allow the customer to add products to a "shopping cart" until they decide to check-out and pay for their purchases.

An example of the menu structure for an on-line Web based clothing sales company is illustrated at FIG. 1. Among other options, the introductory screen **10** allows the customer to check on previously placed orders **15**, and contact customer assistance **14** where they can find telephone contact information, store locations, and general categories of product. The customer is also able to move directly to major product categories of Women's clothing **11**, Men's clothing **12** and Children's clothing **13**. Once in the major product category, the customer is provided additional product category options, such as Pants **16**, Shirts **17**, Shoes **18** and Accessories **19**. The product categories are further subdivided and may contain forms or individual pages **21, 22, 23**.

Using a menu structure like FIG. **1**, with links between on-line Web databases and inventory/shipping databases, the customer receives near real-time information on product availability with current pricing. The business is also able to automatically process orders and track inventory.

With a well developed and designed on-line Web sales architecture, the personnel costs for a business are very small. Personnel are still required for quality assurance and physical actions such as shipping and receiving. However, the need for live sales support staff can be significantly reduced or minimized.

FIG. **2** illustrates a typical menu structure for IVR telephone product sales. In the initial IVR menu **25**, the customer hears about the top level choices. These choices include checking on a previous order **30**, contacting customer support **29**, or moving directly to the main product categories, such as women's clothing **26**, men's clothing **27** or children's clothing **28**. The main product categories are farther subdivided into areas like accessories **31**, blouses **32**, slacks **33** and shoes **34**. There may be further subdivisions or menus **35, 36, 37**.

As thus described and illustrated in FIGS. **1** and **2**, the menu structures for IVR telephone sales and the on-line Web sales may be similar or identical, illustrating the benefit of linking the supporting databases. However, merely linking the supporting databases does not reduce the up-front development costs for IVR. Providing a system and method to analyze the on-line Web sales database and menu structure and adapting that database and menu structure to build an IVR system is beneficial.

HTML Web pages that use forms and structured databases adhere to predictable standards. This is particularly true when the HTML pages are created with Web page authoring applications. These authoring applications adhere to the HTML standards and produce repeatable HTML structure that lends itself to automated analysis.

Referring to FIG. **3**, at step **50**, a previously developed Web page on-line sales site is identified as suitable for IVR and telephone sales. Using the Uniform Resource Locator (URL) of the Web page, the system begins an initial analysis.

At step **51**, the system links to the URL of the donor Web page and down-loads the HTML document that generates the home page. This step of down-loading is the same or identical to the down-loading that occurs when a Web browser links to a specified URL and down-loads an HTML document associated with that URL.

At step **52**, the system identifies the down-loaded HTML page as the level zero menu page.

At step **53**, the system scans the HTML source code and identifies every URL link contained within the HTML level zero menu page as a level one menu item. Though some links, such as links to the webmaster, may not be appropriate for an IVR system, at step **53**, it is not necessary for the system to differentiate between different links.

At step **54**, the system sets a counter, K, to the number of URL links identified on the level zero menu page.

In steps **55** through **59**, the system begins a systematic loop to down-load the HTML page for each of the K URL links identified on the level zero menu page.

At step **55**, the system down-loads the HTML document associated with the Kth URL link item. This down-loaded HTML page is a level one menu page.

At step **56**, the system scans the HTML source code of the level one menu page and identifies each URL link. Each URL link identified at step **56** points to a level two menu item.

At step **57**, the system decrements the counter K, by one.

At step **58**, the system checks to determine whether K is zero, indicating that the system has down-loaded all URL links for that level menu page.

At step **59**, if K is not zero, the system loops to step **55** and down-loads the next URL link.

After the system has down-loaded all URL links for that level menu page, the system leaves the loop.

At step **60**, the system completes the identification of the level zero menu by identifying all level one menu items on the level zero menu. With the loop of steps **55** through **59**, the system also identifies all the level two menu items on each of the level one menus.

At step **61**, the system similarly identifies and down-loads the HTML documents associated with each URL link on the level two menu pages. The links are level three menu items. Though the individual steps are not illustrated, the system uses a process similar to that illustrated in steps **53** through **59**.

At step **62**, the system similarly identifies and down-loads the HTML documents associated with each URL link on the level three menu pages. The links are level four menu items. The steps are similar to those illustrated in steps **53** through **59**.

At step **63**, the system continues the process until it has identified all UTRL links that branch from the level zero menu page identified in step **52**.

Though not illustrated in the example, as the system identifies URL links and down-loads HTML documents associated with the URL link, the system does not blindly follow every link. Links that point to URLs located outside the company business area are considered suspect links. For example a company Web sales page may have a URL link to the home page of a product manufacturer. The system does not follow that link. Instead, the system marks the URL link as such and moves on to the next URL link.

At step **64**, the system performs a clean-up of the links and data. For example, on some web pages, there may be links

that become recursive, linking back on themselves. At step **64**, the system identifies these recursive links and marks them as such. The system also identifies Web unique types of links that do not readily translate to IVR and marks them as such. Examples of these type of unique links include mail to: links that send e-mail to Web-masters. However, a mail link to the customer service department is not unique and the system will translate that type of link to a telephone link.

As the system identifies URL links and down-loads associated HTML documents, some will include Forms-based HTML pages. At step **65**, the system uniquely identifies these Forms-based links for IVR database needs.

At step **66**, the initial automated analysis is complete and the system provides an operator with a visual representation of the menu structure identified during the Web page analysis. This visual representation includes identification of links outside the business area, recursive links, Web-unique links and questions. The visual representation also includes an identification of the Forms-based links and the supporting databases for dynamic HTML pages.

At step **67**, the system gives the operator an opportunity to verify the analysis by tracking through the Web page and site to resolve questions on the analysis.

Once the operator is satisfied with the basic translation of Web menu architecture to IVR menu architecture, the system creates an IVR outline. This is further illustrated on FIG. **4**. At step **70**, the system uses the operator validated menu structure and database linkage to create the initial IVR menu structure and proposed IVR prompts.

At step **71**, based on the proposed prompt, the system generates voice prompts for each menu item in the IVR.

At step **72**, the system generates desired IVR responses to each prompt on the menus.

At step **73**, the system associates voice generation to database text that provides an item description. For example, with a Web site that includes a text description of the product, the system will link a voice generation system to that text description database item. In this manner, the system uses the textual description contained in the database to generate a spoken description of the item.

At step **74**, in a similar manner, the system associates voice price generation to database price items.

At step **75**, the system replaces order placement scripts from the Web page with IVR developed order scripts. This helps to ensure consistency in the order placement and takes advantage of time already spent developing efficient IVR for order placement.

Once the IVR menu structure, prompts and responses are developed, the system has completed the initial translation.

For translation and interpretation of Web menus, system **79** is illustrated in FIG. **5**. An on-line Web-based electronic sales system, taking advantage of forms-based HTML Web pages, uses a variety of structured supporting databases **80**, **81**. One structured database includes the static content of the HTML documents **80**, and another structured database **81** which includes information used with dynamic HTML such as product description and pricing. These two structured databases are accessible to a Web server **82** which is registered as the homepage URL and includes the addresses of all URLs within the Web sales architecture. The server functions as the homepage URL and URL of all linked pages. The HTML documents and information in databases **80** and **81** are thus associated with the URLs.

The system also includes a first switch **83** providing accesses (not illustrated) to Web server **82**.

An individual computer **84** is electronically linked to Web server **82** via first switch **83**. These elements of the system are typical of the configuration used for Web on-line access.

The system **79** also includes elements supporting IVR. These IVR support elements include an IVR **85** which is electronically linked to Web server **82**, thereby allowing direct exchange of information and commands between Web server **82** and IVR server **85**.

A second switch **86** providing support for IVR operation is linked to IVR server **85** and provides a connection path for telephone **87** to IVR server **85**.

System **79** allows an operator, with access to computer **84** and telephone **87**, to monitor the automated translation of the Web menu structure to an IVR menu structure with prompts and responses. System **79** also allows the operator to modify the proposed IVR structure and resolve questions.

As system **79** performs steps **50** through **75** on FIGS. **3** and **4**, the operator is able to visually monitor the progress on computer **84** as the system translates the Web menu structure and develops the IVR menu structure. System **79** also allows the operator to test the IVR structure using telephone **87** and resolve problems by referring to the Web menu structure on computer **84**. The system also provides access to the structured supporting databases **80**, **81** allowing the operator to test changes to the database to determine whether the IVR responds appropriately.

After system **79** translates the Web menu structure and develops the IVR system, the operator validates the translation and provides any required changes. The validated IVR system is then placed in operational service along with the Web on-line system for customer service. This is illustrated in FIG. **6** with system **99**.

In FIG. **6**, system **99** uses common structured databases **101** and **102** as the information source for Web on-line services and IVR services. On-line customers access the Web page by using the URL of the Web page to connect individual computers **105**, **106** to the Web server **103** through a switch **104**. Once connected, the customer is able to browse the Web site and access information on products. The information is contained in structured databases **101** and **102** and is linked to the Web pages using dynamic HTML by the Web server **103**.

In a similar manner, system **99** uses the same common structured databases **101** and **102** as the information source for the IVR service. Telephone customers dial the access number of the IVR service using telephones **109** and **110**. They are connected to the IVR server **107** by switch **108**. IVR server **107** provides IVR prompts based on customer responses and information in databases **101** and **102**.

As illustrated, databases **101** and **102** contain product specifications and pricing information. Thus, common database information supports both the Web on-line service and the IVR service.

In FIG. **6**, first switch **104** and second switch **108** of system **99** are illustrated as individual elements, but they can be a single element providing switching between the appropriate users and servers. Similarly, Web server **103** and IVR server **107** are illustrated as individual elements, but a single server can be partitioned to perform the required functions of each.

In FIGS. **5** and **6**, the servers, switches and databases of systems **79** and **99** are labeled with unique numbers. Separate systems segregate the development system from the operational system. However, a single system can be used for both the development system and the operational system.

The system and method are described in the context of using previously developed on-line structured databases, such as for Web sales, as the basis for IVR telephone sales structured databases. The converse is also possible, where a company uses its structured IVR database as the basis for automatic generation of an on-line Web sales database.

In a method similar to the method just described, translation of an IVR menu architecture to a Web page architecture requires analysis of the IVR menu, and creation of Web pages corresponding to different menu levels in the IVR. Translation also requires creation of the link relationships between the Web pages corresponding to IVR choices and responses. The systems illustrated in FIGS. **5** and **6** are used to translate IVR menus to Web menus.

Referring to FIG. **2**, the system creates a home page using the introductory IVR menu **25**. The introductory IVR menu includes prompts and non-response information. The home page includes this non-response information, such as the company name or welcome message, which is extracted from the IVR introductory menu. Though a completed Web page may not contain this information, the information does provides a good default for content of the Web home page.

The IVR introductory menu **25** also contains prompts or choices **26, 27, 28, 29, 30** which relate to other IVR menus or actions. Thus, each of the IVR choices presented in the introductory IVR menu **25** becomes a link to another Web page or service from the Web home page. In the same manner illustrated in FIGS. **3** and **4** and described above, where the system systematically analyzed the Web menu architecture to create an IVR menu architecture, the system systematically analyzes the IVR menu architecture and creates a Web page architecture with a home page and linked pages. IVR prompts, choices and responses define the links to and between Web pages. In a manner described in greater detail below, IVR choices that connect to live sales or support staff become either "Click-to-Dial" telephone links on the Web page, or e-mail responses.

After the initial Web page structure is created, the system allows an operator to add graphics and text enhancements to the Web pages. The system also allows an operator to modify the Web page structure if the initial structure is not appropriate.

Taking advantage of a system and service termed "Click-to-Dial", a Web page may contain a link to automatically initiate a telephone connection between a personal computer user accessing the Web page and another party. This "Click-to-Dial" or "Click-to-Talk" service appears as a link on the Web page. However, when activated, this service establishes a voice telephony connection to the person accessing the Web page. As an example, when a user accesses an AT&T Web page there is a link area on the Web page, under the heading "Ask about your bill." The user enters their telephone number in a box on the Web page and clicks on the link. In response, AT&T automatically establishes a call-back to that telephone number, which is handled by an AT&T service representative. Once the call-back is established, the service representative can discuss the person's account, and can even send specific web pages or information to the user for viewing and discussion during the telephone call.

Referring to FIG. **8**, another embodiment is illustrated. A Web page **300** is displayed by a browser application **302** on a video display terminal such as the video display terminals of computers **84, 105, 106** of system **79** and **99**. The Web page display provides a graphic representation of an IVR menu architecture. The graphic representation is generated by system **79** or **99** by analysis of the IVR menu architecture, as previously described. However, where the analysis of the IVR menu architecture previously described produced a series of Web pages with links between the Web pages corresponding to different IVR menu choices, the Web page display of this embodiment graphically represents the entire IVR menu architecture on a single Web page. Though the display in FIG. **8** is a graphic representation, it can be a purely textual representation with different menu levels represented by varying indentation.

Through an analysis of the IVR menu architecture, system **79** or **99** identifies and creates a series of nodes **304, 306, 308** and linkages connecting the nodes **320, 322, 324**. Each node represents an IVR menu prompt. The linkages represent the various possible response prompts for the node. IVR systems frequently allow forward and reverse navigation through the IVR menu architecture, so users can go up or down the menu hierarchy to reach different branches without terminating a call. Therefore, the IVR menu prompt for Hardware will include choices for selecting ordering **310**, warranty **312** and assembly **314** which are selected by the user by entry of the numbers **1, 2** or **3** respectively on the keypad.

Thus, a user calling the IVR Help system that is graphically represented in FIG. **8** initially dials a telephone number and hears an introductory welcome message and hears a series of prompts for different responses. That introductory message and prompts are graphically represented by node **304** in FIG. **8**. In the example, the user has selection choices of Hardware or Software. When these choices are presented by an IVR system alone, the user hears a description of those two choices and responds by either speaking the desired choice ("one" or "two"), or selecting the desired choice by pressing either the 1 or 2 key on the telephone keypad. System **79** or **99** graphically represents the introductory welcome message and choices with nodes **304, 306, 308** and linkage **320**. Similarly, system **79** or **99** graphically represents the description and choices for the Hardware prompt **306** and associated choices with nodes **304, 310, 312, 314** and linkages **320, 322**.

It should be noted that because an IVR menu system allows a user to move up and down the menu structure, the Web page representation similarly maintains those relationships. In the IVR environment, a user may move up and down the IVR menu hierarchy. For example, return to the previous menu is accomplished by entry of * or some other choice on the keypad. In this manner, if the user determines that the choice is not the correct choice, they can backup to a previous menu rather than hang-up and redial. For example, if the user is at node **306** in the IVR menu as represented in FIG. **8**, they will go back up the IVR menu to the main menu **304** if they press *. Most IVR systems also allow a user to return to the main entry menu by selection of a choice like # or 9. Thus, if the user is at node **314** in the IVR menu as represented in FIG. **8**, they will go to the main menu **304** by pressing #. This navigation functionality is maintained in the invention.

Though not illustrated, it is also possible that an IVR system will allow a user to reach the same service representative by multiple paths. The Web page duplicates that architecture and illustrates the relationship between nodes with linkages.

In this manner, the Web page graphically represents the IVR menu architecture by providing an overview of the entire IVR menu architecture on a Web page. By presenting this type of overview, a user is able to visually determine

how the IVR choices and responses, represented by nodes and linkages, are interrelated and whether a particular series of responses will lead to the desired service representative.

For most IVR systems, the user is only able to interact with a service representative at a termination point following responses to a series of choices. For example, with the IVR menu architecture that is graphically represented in FIG. **8**, a user who dials the main IVR telephone number will hear an initial IVR prompt and respond to the choices in an introductory welcome menu. Based on whether they select the Hardware or Software choice, the user will next hear an IVR prompt and respond to the choices for their selected Hardware or Software choice. It is only after this selection that the user is connected to a service representative. Though the example in FIG. **8** has three menu levels, IVR systems frequently have multiple menu levels before reaching a service representative. Thus, a user who is uncertain as to which series of choices will take them to the desired service representative can become lost or discouraged as they navigate through the choice and response maze.

With a graphic representation of the IVR menu architecture, such as provided in FIG. **8**, the user is able to visually determine the particular choices necessary to reach a desired service area. In addition, when system **79** or **99** creates the Web page representation of the IVR menu architecture using interactive links, a user can directly select the desired service area from the Web page. For example, a user who has a software installation problem can view the IVR menu architecture illustrated in FIG. **8** and determine that the desired service representative is at node **316**. If the user places their Web cursor over that node they can receive additional descriptive information such as through pop-up text boxes, mouse-over text boxes or right-click action. If the user selects that node, the system will connect the user to that service representative.

This connection to the service representative is accomplished in a number of different ways. In one method, system **79** or **99** automatically dials the main IVR menu number, represented by node **304**. Then, knowing that the desired software installation node **316** is connected to the software node **308** which is connected to the introductory node **304**, the system automatically enters the appropriate response to select the software node, followed by the appropriate response to select the installation node.

With the IVR system alone, if the user selects the hardware response by pressing the number **1** on the keypad and the software response is selected by pressing the number **2** on the keypad, then system **79** or **99** will automatically dial the main access telephone number for node **304** followed by the number **2**, to automatically select the software node **308**. System **79** or **99** then further dials the number **1** to reach the installation representative at node **316**. In this manner, system **79** or **99** takes advantage of the IVR menu architecture and automatically navigates that IVR menu architecture to connect the user with the desired service representative. In this manner, system **79** or **99** automatically replicates the IVR choices. Replication of IVR choices is described in greater detail below.

In another embodiment, the termination point nodes represented in FIG. **8** have a direct access telephone number. Thus when the user selects the software installation node **316** on the Web page, system **79** or **99** dials the direct access telephone number for that service representative. In this manner, system **79** or **99** automatically bypasses the IVR choices.

These embodiments are particularly advantageous when the number of choices and responses in the IVR menu before reaching the desired service representative is lengthy and the system must wait for each IVR prompt before automatically selecting the appropriate response. In this manner, system **79** or **99** can either emulate or bypass the IVR choices.

Referring to FIG. **9**, at step **401**, the system interprets the IVR menu architecture and creates the graphic representation of the IVR menu on the Web page **401**. An example Web page is displayed in FIG. **8**.

At step **403**, the user views the representation of the IVR menu, identifies and selects a desired node by clicking on that node. In the example Web page of FIG. **8**, this could be accomplished by placing a cursor over node **316** to learn more about the node through a mouse-over text box and then double-clicking the node.

At step **405**, the system interprets the connection information from the IVR menu and places a telephone call to the service associated with that node. Thus, using the example of FIG. **8**, the system uses the information from the IVR menu analysis and the user selection to automatically dial the main IVR telephone access number that is associated with node **304**. Next the system dials the number **2**, to reach node **308** and finally dials the number **1** to reach the installation node **316**. These telephone connections are placed using a TAPI connection or Internet telephony connection.

With a TAPI connection, the system takes control of an attached telephone handset and automatically dials the main menu access telephone number (node **304**), waits until a connection is established and the IVR system is prepared to accept selections, automatically dials the number 2 (node **308**), waits until the IVR system is again prepared to accept selections and then dials the number **1** to connect to the software installation node **316**. The user conducts the telephone call with the telephone handset.

With an Internet telephony connection, the system uses an Internet connection to connect to a server that provides Internet telephony services. Once connected, that server makes the telephone connection much like the TAPI connection by automatically dialing the required IVR numbers. However, the user conducts the telephone call using the multi-media features of the computer rather than a telephone handset. For example a microphone and speakers attached to the computer become the functional equivalents of the telephone handset. The user speaks into the computer microphone and hears the conversation over the computer speakers.

It is also possible that a user will not wish to place a call at that time, or wishes to record the IVR responses for later use. The system displays the sequence of access numbers on the screen, or stores them to a user address book or a personal digital assistant for later use.

At step **407** in FIG. **9**, after the user has reached node **316**, they may determine that they want another node. In one form of IVR, the final choice in a tree structure connects with a live service representative. In this form, the user must generally re-dial the main number to reach another service representative, though some IVR systems allow the user to be re-connected to the system by the service representative. In another form of IVR, the final choices in a tree structure play a recorded message or generate an automatic voice. This could occur when a user accesses a bank IVR system to determine their current balance at one choice and then shifts to another choice to transfer funds or pay bills. In this form, the IVR system pauses at the termination point and waits for the user to provide additional instructions.

Using the current example at step **407**, after the user hears a recording on software installation, if they also have a

warranty question, they may want to connect to node **312** of FIG. **8**. In this example, the system has paused at node **316**. The user moves the cursor over node **312**, verifies the node action as described in a mouse-over text box, and selects the node by double-clicking on the node.

At step **409**, the system compares the user's current location (node **316**) with the desired location (node **312**) and interprets the required actions to reach the desired node. Using the example of FIG. **8**, with the user at node **316**, the system determines that * will connect to node **308**, then * will connect to node **304**, then **1** will connect to node **306** then **2** will connect to desired node **312**. Alternatively, the system can determine that from node **316**, # will connect to node **304**, then **1** will connect to node **306** then **2** will connect to desired node **312**.

Thus, one advantage of coordinated Web and IVR menu structures is that while many people prefer the personal contact available with telephone sales, they dislike the often complex and confusing menu structure of IVR. Using related IVR menu architectures and Web menu architectures makes an integrated service much easier and more cost effective. The IVR menu architectures readily translate to Web page architectures and IVR choices or prompts that would normally connect a user to a live service representative can be implemented in the Web architecture as "Click-to-Dial" links. The method and system thus preserves personal interaction while providing a web alternative to complex IVR menu structures in order to reach a particular service or individual.

Although illustrative embodiments, and various modifications thereof, have been described in detail herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to these precise embodiments and the described modifications, and that various changes and further modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.

That which is claimed is:

1. A method comprising the steps of:

analyzing a menu structure that supports interactive voice response users;

creating a web page which embodies a graphic representation of prompts contained in the menu structure;

generating links to the menu structure based on the analysis, the links being usable for on-line users;

receiving inputs from an on-line user which correspond to selection of one or more of the prompts;

linking the on-line selection of prompts to corresponding interactive voice response prompts;

connecting the on-line user to a choice of the menu structure based on the selected prompts; and

selecting a representative to communicate with the on-line user based on the execution of the selected prompts.

2. The method of claim **1**, wherein said step of connecting the on-line user to a choice of the menu structure is by a telephone connection.

3. The method of claim **2**, wherein the telephone connection is a TAPI connection.

4. The method of claim **2**, wherein the telephone connection is an internet telephony connection.

5. The method of claim **2**, the connection replicating interactive voice response prompts.

6. The method of claim **2**, the connection by-passing interactive voice response prompts.

7. A method comprising:

analyzing a menu structure that supports interactive voice response users;

generating a representation of the menu structure using the analysis, the representation being usable for on-line users;

connecting an on-line user to a choice on the representation of the menu structure by a telephone connection, wherein the telephone connection is a TAPI connection.

8. The method of claim **7**, the connection replicating interactive voice response prompts.

9. The method of claim **7**, the connection by-passing interactive voice response prompts.

10. The method of claim **7**, wherein the telephone connection is an internet telephony connection.

* * * * *

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-	42	(((software near2 (keyboard keypad)) and computer and server) and (url uri html internet web web$page)) and (keypad key$pad) and (phone tele$phone) and computer and display	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/02/19 14:34
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-	30	(computer and (keypad with image)).ab.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/02/19 15:34
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